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COST ANALYSIS BUDGET TO EVALUATE OPERATING ALTERNATIVES FOR OIL REFINERS

by JOHN L. FOX
Emlenton, Pa.

What will happen "if"? Perhaps the accountant has not been telling management all he knows—or could know—about the relative costs of alternative courses of action. The present article, related to the circumstances of petroleum refiners, develops a tool for this purpose on the flexible budget principle and offers applications in five situations.

THE criterion upon which refinery costing should be judged is the amount of aid it will offer refinery management. Will costing efforts be a real help to refinery executives in making decisions involving a choice between alternative courses of action? Too often this objective is relegated to a secondary position, the primary position being taken by an attempt to find the "actual" unit costs. At the risks of seeming dogmatic, it would appear that the emphasis which has been given to allocation of crude cost to refined products offers no particular aid to management.

The more realistic approach would seem to be to consider the refiner's costing problem as one involving differential costs and cost analysis. A differential or incremental cost represents the net effect of the choice of alternatives. These alternative courses and the differential costs associated therewith form the subject matter of this article. However, some knowledge of refinery processing is a necessary prerequisite to an understanding of the problems requiring a choice between alternative courses. For this reason, the paragraphs which immediately follow offer a simplified explanation of these processes and the questions of choice which they raise.

Oil Refining; The Emergence of Intermediate Distillates

Refining, in its elementary form, involves vaporizing of the crude oil by heating it to a high temperature, collecting the resulting vapors, and condensing them back into a liquid state. The basic petroleum products are obtained through a physical change caused by the application of heat through a wide temperature range. The initial application of heat drives off the lightest fractions, the naphthas and gasoline; the successively heavier fractions, such as kero-

sene and gas oil, follow as the temperature rises. This process of vaporizing the crude and condensing the gaseous vapors to obtain the various "cuts" is commonly referred to as primary distillation. Certain of these cuts are marketable with but little treating while it is necessary for the others to undergo further processing in order to make them more readily salable and, therefore, more valuable. Thus, heavier fractions, such as kerosene and gas oil, may be subjected to cracking and consequently made to yield a more valuable product, i.e., gasoline. The heaviest of the fractions resulting from primary distillation is known as residuum or heavy bottoms. This residuum, after processing, treating, and blending, forms lubricating oils and ancillary wax or asphalt products.

The unit which brings about this physical separation of the crude oil into its component fractions might be thought of as constituting the primary process in refining. As the primary process, it separates the various fractions which may serve as charging stocks for the secondary processes. The term "charging stock" as used in refining terminology refers to unfinished products which are to be further processed in some secondary refining operation. These secondary processes constitute additional refinery treatments which either result in new products or bring primary products up to required quality standards. The charging stocks or intermediate distillates resulting from primary processing usually include the following: naphtha, kerosene, distillate fuel oil, gas oil, wax distillate, 600 steam refined stock (cylinder stock).

Buy and Process? Sell or Process Further?

The real problem facing refiners is in deciding whether to purchase intermediate distillates for further processing or whether to sell intermediate distillates on hand without further processing. The general underlying factor which is responsible for the emergence of this problem is the inherent nature of petroleum refining. Refining requires the separation of *all* the fractions from the crude oil even though only one or two may be desired. Increased demand for one fraction may result in an oversupply of complementary fractions. The refiner must be continually deciding what to do with all the fractions, not just the one which forms the basis for the product in highest demand.

This involves determining at what stage of refining each product or stock will ultimately be sold and also what routing will be used. Certain fractions can be sold with little secondary processing.

These include naphtha, kerosene, and distillate fuel oil. However, by making use of alternate routings these three cuts can be cracked to produce gasoline and some fuel oil. Another phase of the same problem arises in connection with the lubricating stocks, wax distillate, and 600 steam refined stock. Wax distillate yields viscous neutrals and paraffin wax while the 600 stock results in bright stock and amorphous (black) wax. The finished motor oil is a blend of the light, clear neutrals and the heavier, darker bright stock. These lube stocks may be salable at various gradations of processing or quality refinement.

Still another phase of this problem is the possible purchase of distillates offered for sale by other refiners. The choices of the preceding paragraph are not just a one-way propostion. It may be possible to buy certain stocks at various stages of refinement and transform them into products of higher commercial value. For example, the refiner may purchase 600 stock and refine it into finished bright stock.

Profits Depend on Proper Selection of Alternatives

Raw crude cost constitutes from 75 to 85 per cent of the total cost of all refinery products. Consequently, the margin of profit is actually dependent upon what products are obtained from the crude oil rather than upon fluctuations in operating expense. Thus the refiner must produce the right product at the right time. Production planning can make or break the refiner. This planning should be based upon quantitative as well as qualitative factors. Too many refiners base their production policies entirely upon the latter aspects. It is up to the accountant to furnish management with information regarding the quantitative elements which should play a large part in influencing managerial decisions.

The dominant factors influencing the refiner's choice of alternate courses might best be termed qualitative variables. This bias toward the qualitative aspects of certain problems may at times result in the refiner unknowingly following an unprofitable course of action. However, these factors must not be ignored but should be considered along *with* the quantitative elements.

Myriad Considerations Complicate Buy and Sell Choices

Charging stocks are likely to be quite heterogeneous, due to the vagaries of refinery type, degree of refinement, and the type crude from which they originate. Consequently, it is necessary for the

vendor to state the characteristics of the stock such as flash point, viscosity, etc. The purchasing refiner will first consider his possible selling price for the potential finished products contained in the charging stock, then he will try to decide how much he can profitably pay. "Rule of thumb," as applied by a shrewd and experienced executive, usually determines the price, quantity, and type of stock purchased or sold.

Price situation and market trends—Management's view of market trends in regard to individual products is an important factor in its decisions. If it appears to management that fuel oil is going to rise in price, then gas oil may be held for later sale as fuel oil rather than used currently as a charging stock for the production of additional gasoline.

Bargaining element—Since there are no published markets for unfinished products, the element of bargaining plays a large part in the final purchase or sale. Refiners get an idea of the current worth of the various stocks from a daily price reporting service. This is probably the only printed source on current pricing of the intermediate distillates and, as such, represents the opinion of the reporting service, not a published market.

Commitments—A refinery may have certain marketing commitments, which would make complete flexibility of action impossible. Such marketing agreements may require continued production of one end product even though an alternate routing would be more profitable at the moment.

Dumping—A refinery may find that it can materially increase its sales volume and utilize all available capacity by selling part of its production at a reduced rate. Before such a step is taken, management should contemplate what effect this policy will have on existing sales at established prices.

Available capacity—A refiner would have to pass up potentially profitable purchases if secondary refining units were already scheduled for 100 per cent of capacity. Imbalance in the secondary refining units as a result of differing departmental capacities could definitely influence the selling or purchasing of intermediate stocks.

New units—A refinery may have purchased new units for use in certain secondary processing operations. It might be profitable to buy additional charging stocks on the open market for these

units. Conversely, if a refiner were using obsolete equipment in a secondary refining operation, he could well be a high cost producer. Sale of the pertinent charging stocks might be more profitable than using the old unit.

Storage space—At times practically every tank in a refinery may be full. This condition could affect the refiner in two ways. First, opportune purchases of intermediate distillates could not be consummated. Second, the refiner may be required to sell certain stocks currently being produced at whatever price they can be moved, due to lack of tankage. Perhaps the demand for fuel oil and lubricating stock makes increased production desirable. Yet an increase in such production might not be feasible because of lack of space to store kerosene and other resulting "joint products."

Differential Cost and Differential Income: An Example

No really analytical or scientific approach to the refiners problems in this whole area can be made without accurate and timely cost data. Cost must be regarded in an alternative sense, rather than stressed in its absolute and historical aspects. Alternative costs should reveal the favorable and unfavorable sides of any given decision and offer an analytical comparison between possible policies or actions. This alternate type of approach to the problem requires the use of differential analyses based on differential costs taken from departmental flexible budgets. As previously stated, differential costs represent the net effect of the choice of alternatives.

The differential idea might be illustrated by a simple example. A refiner has a supply of kerosene on hand. He wishes to know if he should sell it as kerosene or use it as charging stock for cracking. It should be evident that he can not make a really intelligent decision unless he knows the incremental cost of cracking the kerosene supply. The differential cost will be the cost associated with cracking that kerosene. It is the difference between the cost that will be incurred by the cracking department at the consequent higher level of production and the cost incurred at the present volume of production. The differential income is the difference between the potential revenue from the cracked kerosene (i.e., gasoline and residual fuel oil) and the revenue available from the sale of kerosene, as such. If the differential income exceeds the differential cost, then the further processing is justified cost-wise.

Departmental Cost Analysis Budgets

The cost accountant can help management most through the preparation of departmental cost analysis budgets for the secondary operating departments (i.e., cracking, treating, solvent dewaxing, solvent extraction, etc.). In this way management will know the differential costs upon which many important decisions are now based, either knowingly or unknowingly. If these cost analysis budgets can set forth differences in price or income resulting from alternative courses, then they will have more than contributed to profitable operation.

Cost analysis budgets differ from control budgets in several respects. All expenses are included in the analysis budgets. The budgeted expenses of the service departments are allocated to the operating departments at the corresponding capacity levels. In order to distribute these service department expenses properly, they must be separated into fixed and variable components. Then each will be distributed on its proper basis.

The number of percentage capacity intervals budgeted will vary with individual plant need and the availability of information. As data is accumulated regarding past behavior of expense patterns, it should be possible to budget in smaller gradations of capacity. The goal of these analysis budgets is to discover the departmental differential unit costs. These differential costs represent expenses specifically incurred for an additional increment of production. They are costs directly associated with and assignable to the incremental increase in the volume of production.

Exhibit 1 is illustrative of a cost analysis budget of the sort here advocated. The amounts to be stated for each class of expense at each production level must be arrived at on separate work sheets on which the various individual expenses are separated into their fixed and variable elements. This separation is necessary to arrive at the estimated expense for each level of production.

The remainder of this article is devoted to five examples illustrating the use of differential cost data in the solving of several hypothetical problems involving a choice between alternative courses of action open to oil refiners. These illustrations should not be construed as an attempt to prove the infallibility of analysis budgets. Differential costs cannot eliminate the risk of wrong decisions. However, differential costs as presented in the analysis budgets should definitely limit the chance of making an improper

COST ANALYSIS BUDGET

Department: Cracking Period Budgeted..... To .....
Supervisor ..... Normal Capacity (100%) 100,000 Gallons Through-put

Department and/or Expense Account		Shut-down	60%	80%	100%	120%
Direct expense:						
Direct labor	53-1					
Superintendence	53-2					
Supplies	53-3					
Repair materials	53-4					
Repair labor	53-5					
Depreciation	53-6					
Fuel-Natural gas	53-7					
Fuel-Cracking plant gas	53-8					
Royalties	53-11					
Miscellaneous	53-12					
Clean-out expense	53-16					
(Gas produced)	(53-20)					
(Fuel oil—produced and used)	(53-21)					
		$3,000	$7,000	$8,000	$8,500	$11,500
Allocated expenses:						
Fixed:						
Power and boilers	60					
Control laboratories	61					
Research laboratories	62					
Water plant	63					
Storage tanks	64					
Operational overhead	65					
General refinery overhead	66					
Variable:						
Power and boilers	60					
Control laboratories	61					
Research laboratories	62					
Water plant	63					
Storage tanks	64					
Operational overhead	65					
General refinery overhead	66					
		$ 500	$1,000	$1,500	$ 2,000	$ 3,000
Total costs		$3,500	$8,000	$9,500	$10,500	$14,500
Through-put:						
Total gallons		0	60,000	80,000	100,000	120,000
Differential gallons		0	60,000	20,000	20,000	20,000
Differential cost			$4,500	$1,500	$ 1,000	$ 4,000
Unit differential cost			$.075	$.075	$.05	$.20
Unit average cost			$.133	$.119	$.105	$.1208

Captions in brackets ( ) call for red figures.

EXHIBIT 1.

decision. An analysis of this type should translate hunches, guess work, and instincts into reasonably logical conclusions.

An alert refinery management will immediately recognize the value of a good quantitative approach to its problems. This does not mean that the management will disregard the qualitative influences previously described. Such factors as the effect of dumping, market commitments, and available storage space will definitely be considered. However, with only the qualitative influences to go by, management is likely to make many wrong decisions that could be avoided if the proper cost information were available.

Application 1—Sell or Process Further

A refiner has on hand 20,000 gallons of fuel oil. He must decide whether to sell it as fuel oil or crack it into gasoline and residual fuel.

The following facts are available:

Current prices: Fuel oil 7¢ per gal., gasoline 14¢ per gal.
Cracking department analysis budget: Present operations 80% of capacity
Differential cost (80% to 100%) = 5¢ per gal.
Cracking yields: 75% gasoline, 15% residual fuel oil, 10% loss.

The refiner can then prepare the following analysis regarding the decision to be made:

Differential Income and Cost Computations

Potential revenue — products from cracking:	
Gasoline 15,000 gal. @ 14¢	$2,100
Fuel oil 3,000 gal. @ 7¢	210
	$2,310
Less, Potential revenue — fuel oil 20,000 gal. @ 7¢	1,400
Differential income	$ 910
Less, Differential cost: 20,000 gal. @ 5¢	1,000
Loss from cracking of fuel oil	$ 90*

* Not an accounting loss, per se, but a loss of profit which would result from an improper choice of alternatives.

Thus, judging from a quantitative standpoint, it would be more profitable to sell the 20,000 gallons of fuel oil, as such, rather than to process it further.

Application 2—Price to Pay for an Intermediate Stock

A refiner has been offered 10,000 gallons of cylinder stock. The usual bargaining process will determine the final price. The would-be purchaser is interested in knowing how high a price he can pay and still make a profit.

The stock purchased would be processed into conventional bright stock and sold at that stage, since the blending unit for making finished motor oils is currently working at full capacity. The information available is as follows:

Cylinder stock is of such a quality and type that it will probably yield: 90% bright stock, 5% petrolatum, 5% loss.

Current prices: bright stock 50¢ per gal., petrolatum—no market.

Differential costs associated with processing 10,000 gallons of cylinder stock through several units (from analysis budgets):

Solvent dewaxing	2¢ per gal.
Solvent extraction	2¢ per gal.
Filtering	1¢ per gal.
Total	5¢ per gal.

Using this information, the refiner can analyze his position and determine his bargaining margin, as follows:

Margin Establishing Limit of Purchase Cost

Revenue—bright stock 9,000 gal. @ 50¢	$4,500
Differential costs, 10,000 gal. @ 5¢	500
Margin	$4,000

$4,000 ÷ 10,000 gal. = 40¢ (point of no advantage)

The refiner is now ready to bargain for the purchase of the cylinder stock. He knows that a purchase price of forty cents a gallon represents his "break-even" point. To pay more would produce a loss, to pay less would result in a gain. He then makes his decision as to how much profit is required to justify the purchase. Here the concept of opportunity costs also enters into the final decision. If the available capacity could be more profitably used for another purpose, then perhaps the proposed purchase should not be consummated.

Application 3—Choice of Alternate Routings

A refiner is trying to decide whether to treat and sell the kerosene fraction or to crack it for its gasoline content. The current decision involves 10,000 gallons of raw kerosene. The pertinent information available to him is as follows:

Current prices: kerosene 8¢ per gal., gasoline 14¢ per gal., fuel oil 7¢ per gal.

Cracking yields: gasoline 85%, residual fuel oil 5%, loss 10%.

Differential costs associated with potential gallons through-put (from analysis budgets): cracking 3¢ per gal., treating 1¢ per gal.

Using the above amounts, the refiner can prepare the following analysis:

Differential Cost and Income—Alternative Routings

Net potential revenue—products from cracking:		
Gasoline 8,500 gal. @ 14¢	$1,190	
Fuel oil 500 gal. @ 7¢	35	
	$1,225	
Less: Differential cost, 10,000 gal. @ 3¢	300	$925
Net potential revenue—Kerosene:		
Total revenue, 10,000 gal. @ 8¢	$ 800	
Less: Differential cost, 10,000 gal. @ 1¢	100	$700
Gain from cracking rather than treating		$225

In this situation, it is apparent that the more profitable alternative is to crack the kerosene fraction.

Application 4—Proposed Construction of Additional Capacity

A refiner discovers that the market for finished neutrals is such that his present capacity does not satisfy the demand. He feels certain that an addition to the solvent dewaxing and solvent extracting units would prove profitable. The additional wax distillate stock required would be purchased on the open market at the current rate. However, before going ahead with the construction he first consults the chief accountant, who presents the following analysis based upon the analysis budgets:

Unit differential cost of increasing operational capacity from 100% to 120% (10,000 to 12,000 gallons):

Solvent dewaxing department..... 10¢ per gal. through-put

Solvent extracting department..... 10¢ per gal. through-put

Assumed yield from wax distillate: 90% viscous neutral, 5% paraffin, 5% loss.

Current market prices: Viscous neutrals 47¢ per gal., white crude scale wax 8¢ per lb., wax distillate stock 35¢ per gal.

On the basis of the foregoing data, an appraisal of the situation is worked up, much as in the case of the applications which have already been cited:

Schedule of Projected Action

Differential Income (100% to 120% of capacity):		
9,000 gal. viscous neutral @ 47¢	$4,230	
1,200 lbs. paraffin @ 8¢	96	
	$4,326	
Less: Cost of wax distillate stock 10,000 gal. @ 35¢	3,500	
Margin to apply against differential costs		$ 826
Differential costs:		
Solvent Dewaxing Department 10,000 gal. @ 10¢	$1,000	
Solvent Extracting Department 10,000 gal. @ 10¢	1,000	2,000
Potential loss from differential production		$1,174

It would appear from the accountant's analysis that the proposed increase in the productive capacity would not be justified.

Application 5—Shutdown Considerations

The analysis budgets should provide important data for use in making decisions regarding possible shutdowns. The fact that an operating department is a high-cost type due to obsolescence may not, for that reason alone, justify its removal from the active list. In making the final decision as to shutdown, the refiner should remember the contribution approach and judge the situation in that light. Under this theory, each dollar of revenue contributes first to variable expenses, then to fixed costs and profits. This marginal contribution to overhead and profit should not be overlooked. A unit that is recovering more than just "out-of-pocket" expenses is making a definite contribution to overhead. The fact that it is not making a profit does not mean that it is not contributing. Unless the unit to be substituted will contribute a sufficiently higher marginal contribution, it would be unwise to arbitrarily shut down an "unprofitable" unit.

Cost Analysis Budgets of Value from Day to Day

This article, with its various illustrative applications, has attempted to show a few of the uses of cost analysis budgets in helping the refiner choose between alternative courses of action. Differential costs derived from these budgets should prove of daily value in meeting many and varied problems. The use of such accounting tools interjects a dynamic quantitative element into everyday management problems.

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IS THE RAW MATERIAL WOOD?— THE ELEMENTS OF SYLVICULTURE ACCOUNTING

by I. WAYNE KELLER,
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In this article, the author offers in narrative style a procedural study in accounting for forestry operations on company-owned timberlands. The paper is written against the background thought that, in more instances than the one described, companies processing wood in their manufacturing operations may be giving consideration to the undertaking of growing operations also.

THE continued depletion of the natural forests of the country and the failure of individual owners of forest land to manage their forests properly is leading more and more of the corporations which use wood as a raw material to "grow their own." Such a program not only assures a constant source of raw material but also tends to reduce its cost. In many instances, these ventures into sylviculture result in accounting problems which are beyond the scope of experience of the company's accountants. It is the purpose of this paper to review some of these problems and suggest possible solutions.

Quest for Timberlands

The examples used are drawn from a program for the acquisition and development of timberlands for the production of pulpwood. It will be assumed that a company is now manufacturing a new product which has as its major component fibers produced from soft wood which it secures from its own forests. Prior to starting the manufacture of this product, the company had no experience in or contact with either wood procurement or sylviculture. When the decision was made to manufacture this product, it was tentatively decided that the company would establish its own source of raw material.

Services of Trained Forester Utilized

From the data on plant capacity, yields, and formulations which were developed as a basis for deciding to go into the business, the

cost accountant was able to develop the maximum annual requirements of pulpwood in cords. However, professional assistance was required in finding the answers to such questions as:

1. How many acres of forest land will be needed to supply the annual requirements of pulpwood under a managed forestry program?
2. In what geographical areas are the desired species of trees found in sufficient abundance?
3. Where in these areas are there large stands of trees and tracts of land suitable for reforestation?

These were questions which only a trained forester could answer. Consideration was given to engaging a public firm to make the necessary surveys and recommendations. However, because plans to grow its own pulpwood seemed relatively definite, the company decided to employ a forester immediately. Thus, while making the studies, he could acquire valuable knowledge of the areas which he could use later in carrying out the purchase program.

The first report of the forester indicated the general geographical areas in which the desired species of trees were found. When these were considered by the manager, it was immediately evident that because of location of markets for the product, sources of supply of other raw materials, and available labor supply, there were only a few locations for the plant and its supplying forests that could be considered. The annual requirements of cords of pulpwood were then used by the forester to determine the acres of land that would be required to produce them. Spot checks were than made of land costs in each area and the maximum expenditure for land and standing timber was estimated. These spot checks also indicated that spot purchases of pulpwood could be made advantageously from time to time in any of the desirable areas. Through such purchases, it would be possible to conserve some of the company-produced wood for cutting in periods of peak demand. Therefore, it was definitely decided to acquire forest land but only enough acreage to cover operations at normal or average levels, and thus reduce the capital investment required. With the objective in acreage definitely established, the forester was instructed to make a detailed study of the areas which appeared more desirable.

The Language of the Enterprise

When this report was presented, it introduced the following new terms into the vocabulary of the management:

DBH —diameter, breast high; i.e., the diameter of the trunk of the tree approximately four and one-half feet above the base.

Saw timber —any tree eleven inches DBH or larger and containing one or more sixteen-foot logs with a diameter at the top diameter of not less than six inches.

Pulpwood —trees of the desired species only, measuring three to eleven inches DBH and containing one or more five-foot sticks to a top diameter of not less than three and one-half inches (trees of this size but not of the desired species for pulpwood were not considered).

Reproduction—trees of the desired species smaller than pulpwood size.

Fields —areas containing no trees.

Cruising —the tallying of the number of trees in an area according to size and species.

Land Purchase Program

The study revealed that there was no area where large stands of the species desired could be purchased. Instead it would be necessary to purchase many small tracts, some with a high percentage of the desired pulpwood, others with mixed species and both saw timber and pulpwood, others with a high percentage of reproduction, and still others of marginal land that could be reforested. Over a period of several years this procedure would provide the desired acreage in reasonably large plots. With proper planting and cutting, it could be brought into exclusive production of the desired species in about ten years. Since all of the areas studied had these same characteristics, the final selection was based on factors other than the stands of pulpwood.

Corporate Setup and Capitalization of Costs

Another fact was also disclosed in the course of the study. All of the areas were in states other than the one in which the com-

pany was incorporated. Some of these states had laws limiting the number of acres of land which could be owned by a foreign corporation. This was true of the state selected as the location of the plant and, therefore, a subsidiary company had to be formed. It was decided that the parent should own and operate the plant with the functions of the subsidiary limited to holding and managing the forest land. Experience showed this to be desirable, for all of the tax problems incident to depletion and reforestation were thus removed from the parent company and localized in the subsidiary.

Purchase Costs Capitalized

With the incorporation of the subsidiary, the stage was set to start the land acquisition program. It was decided that the amounts to be capitalized as cost of land purchased should include:

1. The amount paid to the owner of the tract, including the amount paid for the option, if any.
2. The realtor's commission.
3. The legal fees incident to searching and conveying titles.
4. The surveyor's fee for definitely determining the area and boundaries of the tract.
5. The cost of mapping and cruising the tract by the company forester. This covered the determination of the quantities and species of saw timber, pulpwood, and reproduction on the tract and the preparation of maps showing the location and density of each. This cost was set at a predetermined rate per day based on the actual salaries of the forester and his assistants.

Allocation of Purchase Costs

It was further decided that the total purchase cost would be allocated to saw timber, pulpwood, reproduction, buildings, and land. Since quoted market prices were available for standing saw timber and pulpwood in the area, it was decided to use these for setting the respective values.

Reproduction had no established market price. Therefore, it was decided to base the value of this on the cost to plant open areas. The forester estimated that of every 100 seedlings planted, thirty would die before reaching a DBH of two inches and an

additional twenty would die before reaching pulpwood size. Therefore, it was decided that, in cruising, the reproduction should be tallied in two groups, "two inches and under" and "over two inches." For simplicity, it would be assumed that the count in each case was of trees which would reach the top size limit of the class; i.e., that all trees in the class that would die had already died. Thus the unit cost to plant was divided by .7 to arrive at the unit value of reproduction two inches and under, and by .5 for the unit value of the remaining.

Some of the tracts also contained small tenant houses. It was decided to give these a nominal value and permit the occupants to continue to rent them. Land value would be the residual after deducting the value of saw timber, pulpwood, reproduction, and buildings from the total purchase cost.

Initially, it was decided that this allocation would be made by tracts. However, experience proved this policy to be unsound. On some tracts the value of the trees was found to exceed the total purchase cost. At other times, because of several purchases at very satisfactory prices, it became desirable to pay a relatively high price for a connecting or adjoining tract. Thus the residual land values per acre of the first ten tracts purchased were found to fluctuate rather widely. It was then decided that for the purpose of allocating the cost of purchases to the several property accounts, the entire program would be considered as a unit. This would leave the value of the land undetermined until the program of acquisition was completed. When this was accomplished, the residual value per acre assigned to land was an average for the entire program and, when checked against other sales prices in the area, was found to be well in line.

These procedures appeared to be in agreement with the factors considered by the Federal Bureau of Internal Revenue in approving timberland values for tax purposes, which are:

1. Character and quality of the timber as determined by species, age, size, condition, etc.
2. The quantity of timber per acre, the total quantity under consideration, and the location of the timber in question with reference to other timber.
3. Accessibility of the timber.
4. The freight rates by common carrier to important markets.

Planting Costs Capitalized

In order to bring the entire acreage into production as early as possible, the work of planting some of the fields with seedlings was started before the acquisition program was completed. This work was done by contractors who supplied the necessary equipment and labor. The seedlings were purchased from the forestry department of the state and from private nurseries. It was not possible to plant all of the fields the first year because of the relatively short length of the planting season. This made it necessary to extend the initial planting of areas acquired as open fields over a period of several years. After the entire area is brought into production and is being operated on the planned ten-year growth cycle, the area on which trees are felled each year will be planted during the planting season immediately following. It is planned that these annual plantings shall also be made by contractors. Thus the costs of planting will be the amounts paid for the seedlings and the charges of the contractors for planting them. These costs will be capitalized for they add to the value of the stands of trees.

Accounting Procedure

Thus far, we have reviewed the history of the enterprise and some of the management decisions which were made. A discussion of the accounting policies and procedures has purposely been omitted so that the background information could be presented in continuity. We will now assume that the purchase program has been completed and will examine the accounting transactions and the underlying policies and procedures.

Books and Accounts

Since the sylviculture unit was set up as a subsidiary company, it was decided that it should use the chart of accounts of the parent. Of course, some accounts were added to this chart to cover those assets and transactions peculiar to the business of the subsidiary. This use of the same chart of accounts, with its manual of instructions, tends to assure uniformity of interpretation and recording of all transactions. It also facilitates the consolidation of the accounts of the parent and the subsidiary, which maintained its own accounting records. These included:

General ledger	Property ledger
General journal	Rents receivable register
Cash journal	Property tax register
Tract purchase and cruise register	

The first three of these were of standard form and require no further description. The property ledger was divided into seven sections, each of which contains details of the respective control account in the general ledger. These are:

1. Land—Each tract was recorded individually showing location, boundaries, former owner, and a reference code to permit ready reference to the tract in the tract purchase and cruise register. Values by tracts were not recorded because they were not established as such.
2. Buildings—Each tenant house was recorded individually, showing location, description, value, estimated life, and annual depreciation. (Other than tenant houses, no buildings were owned.)
3. Equipment—Large pieces of equipment, such as tractors, were recorded individually showing description, cost, estimated life, and annual depreciation. Small tools and equipment having an estimated life of two or more years were recorded on a group basis and given an estimated average life of three and one-half years for depreciation purposes. Office furniture and fixtures were recorded on a group basis and depreciated over a period of twelve and one-half years.
4. Saw timber—This was a single page on which were recorded the total board feet and value assigned to saw timber in the tract purchase and cruise register. Provision was made for recording subsequent acquisitions or natural growth, and for depletion.
5. Pulpwood—Same record as for saw timber, but with units in cords.
6. Reproduction—A simple record of the value of reproduction established in the tract purchase and cruise register, together with provision for subsequent transfer to the pulpwood account.
7. Plantings—A record of the cost of planting of each year, with provision for subsequent transfer to the pulpwood account.

TRACT PURCHASE AND CRUISE REGISTER

Tract No. Purchased from:

Location: Area:

Purchase Cost

Date	Voucher No.	Paid To	Description	Amount

Allocation

Building No.	Description		
Saw Timber	Board Feet	Rate	
Pulpwood	Cords	Rate	
Reproduction			

EXHIBIT 1

The rents receivable and property tax registers were standard forms with the information customarily recorded in such books. The tract purchase and cruise register is shown in Exhibit 1. It provides for the recording of the total cost of each tract and the allocation of this cost to the respective property accounts. It is an interim record providing for the summarization of cruise reports (Exhibit 2) as prepared.

Accounting for Tract Purchase Costs

As tract purchases were made, the costs were charged to a control account entitled "tract purchases" and the details were posted to the tract purchase and cruise register. Upon completion of the

purchase program, the values determined for the several classes of trees from the cruise reports were summarized and deducted from the net of the total cost of tracts, less value assigned to buildings. The values of trees and land were then charged to the respective property accounts. The corresponding credit closed the tract purchase account. If subsequent isolated purchases are made, each purchase will be cleared through the tract purchase account. If a decision is made to acquire a specified acreage which will have to

CRUISE REPORT

NAME OF TRACT _____ TRACT NO. _____ DATE _____

LOCATION _____

NO. ACRES IN TRACT _____ NO. 1/4 ACRE PLOTS TAKEN _____

_____ ACRES IN _____ 1/4 ACRE PLOTS % CRUISE _____

TIMBER TYPES	% CRUISED	NO. OF ACRES	% OF TOTAL AREA
Loblolly Pine I			
Loblolly Pine II			
Loblolly Pine III			
Shortleaf Pine I			
Shortleaf Pine II			
Shortleaf Pine III			
Longleaf Pine I			
Longleaf Pine II			
Longleaf Pine III			
Slash Pine I			
Slash Pine II			
Slash Pine III			
Mixed Pine I			
Mixed Pine II			
Mixed Pine III			
Bottomland Hardwood			
Ridge Hardwood			
Open Field			

	TOTAL VOLUME			REPRODUCTION FOR TRACT			
	PULPWOOD		SAWTIMBER	NO. OF PULPING TREES		NO. OF OTHER TREES	
SPECIES	PULPING CDS.	OTHER CDS.	BOARD FEET	0"	2"	0"	2"
Loblolly							
Shortleaf							
Longleaf							
Slash							
Spruce Pine							
Poplar							
Gum							
White Oak							
Red Oak							
Hickory							
Others							
Total							

	MORTALITY FOR TRACT			
	VOLUME LOST ON ACRES/YEAR		VOLUME LOST PER ACRE/YEAR	
SPECIES	CORDS	BOARD FEET	CORDS	BOARD FEET
Loblolly				
Shortleaf				
Longleaf				
Slash				
Spruce Pine				
Poplar				
Gum				
White Oak				
Red Oak				
Hickory				
Others				
Total				

EXHIBIT 2

be purchased in small tracts similar to the original program, then such an entire program will be treated as a unit and will be cleared through the tract purchase account in total, as was the original purchase program.

It is to be noted that provision was made in the reproduction and planting sections of the property ledger for transferring these values to the pulpwood account. This was done because the planting and reproduction accounts were considered merely as suspense accounts in which to hold these values during the period of growth. The forester estimated that ten years would be required, on the average, for a seedling to grow to a size usable as pulpwood. It was assumed that the reproduction areas contained trees in all stages of growth from seedlings to pulpwood, with about the same number in each stage. Therefore, it was decided that ten per cent of the reproduction account value would be transferred into the pulpwood account each year until it was completely liquidated. This will bring into the pulpwood account each year value commensurate with the cords which will be added by maturity of the trees and, at the end of ten years, this account will be completely liquidated and closed.

Accounting for Planting Costs

The growth period of ten years was also applicable to plantings. The planting costs of each year are capitalized and carried as such in the property ledger until ten years after the year of planting. At that time, the cost of planting will be transferred to the pulpwood account. Thus, ten years after the first year of planting, the cost of that planting will be transferred to the pulpwood account. Ten years after the second year of planting, the cost of that planting will be transferred to the pulpwood account, and so on.

Reflecting Annual Growth in the Accounts

Since values are added to the pulpwood account from year to year through transfers from the reproduction and planting accounts, it will also be necessary to add quantities so that the value per cord will not be inflated. This will be accomplished by estimating the natural growth during each year. To do this, the forester will establish a number of test areas. These will be in different locations so as to secure an average picture of growth and give consideration to the different soil and moisture conditions. They will also be selected with respect to their relative stands of

pulpwood, reproductions, and plantings, the object being to secure sufficient area and variety to be representative of the total acreage of timberland.

Intensive cruises of these test areas will be made to establish the number and size of the trees thereon. Each year they will be re-cruised and the quantities thus determined will be compared with those existent at the time of the previous cruise. These comparisons will establish the growth on the test areas for the year. This will be projected to a figure for the total acreage. The number of cords of pulpwood thus determined to be added by natural growth will be entered in the respective sections of the property ledger. Growth during the year will be added to the quantity at the end of the previous year and the sum divided into the balance of the value to establish a new and unit rate, as will be seen from the illustrative pulpwood account shown as Exhibit 3.

PULPWOOD ACCOUNT

Date	Description	Cords	Per Cord	Amount
1948				
Dec. 31	Summary, tract purchases	297,081	$2.00	$594,162 00
1949				
Dec. 31	Growth - 1949	11,500		-
31	Transferred from Reproduction	-		17,200 00
31	Balance	308,581	1.98	611,362 00
1950				
June 30	Depletion - Jan. 1 to June 30	15,480	1.98	30,650 40
30	Balance	293,101	1.98	580,711 60
Dec. 31	Depletion - July 1 to Dec. 31	3,410	1.98	6,751 80
		290,691		573,959 80
31	Growth - 1950	8,600		-
31	Transferred from Reproduction			17,200 00
31	Balance	299,291	1.97	591,159 80

EXHIBIT 3

There will be no plantings of saw timber and no other values added to this account after the initial acquisitions. However, because there may be substantial further growth before the trees are cut, the board feet should also be increased from year to year to reflect growth. This increase will be determined from the test plots, as for pulpwood. When the growth is recorded in the ledger, the effect will be to reduce the value per board foot. The

use of these reduced rates will reduce the total charge for depletion in the years when raw timber is cut. Thus, the profit due to natural growth will be taken in the year of cutting and sale, when it is actually realized.

Cutting of Timber and the Recording of Depletion

Depletion is determined at the close of each year on the basis of the board feet of saw timber and cords of pulpwood cut during the year. Since it is not economical to cut small numbers of trees in separated areas, sections are selected for cutting each year which have relatively dense stands of trees of cutting size. All trees of desired size in the section, saw timber and pulpwood, are then cut down. (Each year there will be less saw timber as older trees are cut down and the areas brought entirely into the production of pulpwood.)

It is of interest to note that the cutting is not done by the company. There are two reasons for this: first, the additional investment which would be required for logging equipment, and second, the labor problems related to cutting. Both of these are relative to the amount of cutting to be done. In the case of the company under discussion, the pulpwood requirements are not sufficient to keep a logging crew busy all of the time. Thus, if it did its own cutting, there would be periods when the equipment would be idle and the men in the crew would not have steady employment. Reduction of the crew to a size that could be kept busy full time would make it impossible to use modern machinery and thus would result in excessive cutting costs. Therefore, the company sells the standing trees in an area to an outside party who makes a business of timber cutting and who agrees to sell the cut pulpwood secured to the parent company at a specified price. This outside party then has the responsibility for disposing of the saw timber which is not wanted by the company.

The quantities established by the forester as the basis for the sales price are used for determining depletion. The board feet of saw timber and cords of pulpwood sold are extended at the unit values for each at the beginning of the year as shown in the property ledger. The quantities and values are deducted from the respective accounts and an entry is made crediting the respective property accounts and charging depletion cost. Such entries are displayed in Exhibit 3.

The sequence of recording growth and depletion in the property ledger is important in securing a correct unit value. Exhibit 3 shows a series of transactions computed and entered in the proper sequence. Depletion for the year must be entered before growth for that year since the trees cut during the year have not grown. Thus, depletion rates are based on the unit values at the beginning of the year. Depletion is then deducted and growth is added to the remaining balance and a new quantity, value, and rate established. This new rate is the rate used for depletion the next year.

Maintenance Expense Not Capitalized

A maintenance crew is employed and works under the direction of the forester. This crew keeps the forests free of underbrush, establishes and maintains fire lanes, posts boundary signs, and occasionally plants small numbers of seedlings in areas where reproduction is light or the mortality of plantings has been excessive. The wages of this crew and their expenses, which include transportation to and from the forest areas, depreciation of maintenance equipment, small tools, etc., are considered as period costs.

It could be argued that the work promotes the growth of the trees and should be capitalized. However, with a fixed acreage planted, and in an established cycle of growth, cutting, reproduction, and growth, the effect on costs of any year is essentially the same if maintenance costs are expensed or capitalized. The only effect would be changes in price levels, the impact of which would be deferred if maintenance costs were capitalized and amortized over a period of ten years, the span of the growth cycle.

Forests Self-Insured by Company on Reserve Basis

It was decided that insurance would not be carried on the forests. Instead, a reserve was established and is credited each year with an amount which is estimated by the forester to represent the average casualty loss probability over a period of years. Provision for this reserve is not deductible for income tax purposes, but it does minimize the effect of a serious fire or other casualty on the operations of any one year.

When fires occur, the forester estimates the quantities of saw timber, pulpwood, and reproduction destroyed. These estimates are based on the records for the stands of trees in the specific area as shown by the cruise maps, adjusted for growth or cutting since

the date of cruising. These quantities are valued at the rates shown by the property ledger. The amount of loss is charged to the reserve for fire loss, to the extent that there is an available reserve. Any loss in excess of the reserve is taken as a cost of the period. The respective property accounts are credited for the values and the quantities are also removed from the registers. Thus the unit values are not changed by a fire.

The tenant houses which were allowed to stand in the acquired areas are an important link in the fire protection and warning system. The occupants are instructed in fighting small fires and on how to notify the forester and state fire fighting units. Fire fighting equipment is located at each tenant house and at other strategic locations in the forests. Thus far, this plan has resulted in the control and early extinguishing of all fires and losses have been negligible. In return for their fire warning service, the tenants are charged a very nominal rental for their houses, and they are paid for time actually spent in fighting fires. These fire fighting costs are also charged against the reserves for casualty loss, to the extent that it is available.

Other casualty loss may result from extensive and abnormal damage by blight, insects, etc. For accounting purposes, such losses are treated in the same manner as are fire losses.

Federal Income Tax Considerations

A special form (T- Timber) is used in preparing Federal income tax returns involving allowances for depletion of timberland or for casualty losses of standing trees. No attempt will be made to discuss the preparation of this form. However, a summary of the basic data is given to indicate the tie-in with the accounting records and procedures already discussed. These required data are:

1. A map showing timber and land acquired, timber cut, and timber and land sold.
2. Description of, cost of, and terms of purchase or lease of timber land acquired.
3. Description of timber with respect to which claim for loss, if any, is made.
4. Record of timber cut.
5. Changes in each timber account as the result of purchase, sale, cutting, reestimate, or loss.

If the company were also manufacturing, it would be necessary to present the following as well.

1. Operating data with respect to raw and finished material handled and inventoried.
2. Unit production costs.
3. Any other data which will be helpful in determining the reasonableness of the depletion deductions claimed in the return.

Transactions for Record in Timberland Accounting

To summarize, in the company used for purposes of illustration, we have the following transactions:

Income:

Net sales—The amount received from purchasers of standing saw timber and pulpwood.

Rent—Payments by the lessees of tenant houses.

Other—Sundry other receipts, such as from the sale of salvage materials.

Deductions from Income:

Salaries—Payments to the manager, forester, assistant forester, accountants, and office personnel.

Wages—Payments to the maintenance crew and casual labor.

Supplies—The cost of gasoline and oil for trucks and tractors, stationers, paint, signs, insecticides, etc.

Small tools—The cost of hand tools having a life of less than one year.

Fees—Payments to independent auditors, lawyers, etc., other than fees related to the purchase of land.

Depreciation—The allowance for depreciation of tenant houses, trucks, tractors, office furniture and fixtures, and miscellaneous equipment.

Taxes—Property, payroll, franchise, income, and other tax payments.

Rent—The amount paid for leased office space.

Casualty loss—The provision for casualty loss and, on occasion, the excess of actual loss over the reserve available.

Depletion—The book value of the saw timber and pulpwood cut during the period.

Other—Such other expenses as are encountered in any business.

Capital Expenditures:

Costs of acquisition—Purchase price and related purchasing costs of tracts.

Plantings—The cost of planting seedlings in open or cut-over areas.

System Developed on Basis of Study and Consultation

These observations have not been tested by years of experience. They represent an approach to the determination of management and accounting policy for a sylviculture enterprise. They have as their background certain literature research, interviews with accountants of companies having many years of experience in forest management, and interviews with foresters. It is believed that they are sound and workable.

A REPORT ON AN INDUSTRIAL ACCOUNTING INTERNSHIP PROJECT

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Industrial accounting is an intensely practical service to business, despite the existence of somewhat difficult theoretical considerations in some of the problems it is called upon to solve. This presentation describes a project under which students of industrial accounting were subjected to its natural environment for a period of time on an on-the-job training basis and suggests that employer and student alike may benefit from such internships.

THIS article is a review of an experience in internship training in industrial accounting initiated by the School of Business of Indiana University in cooperation with the individual controller of a large industrial organization in Indiana who, while serving as a faculty associate, agreed to work with the university to ascertain if such a program would be of value. The purpose of this project was to determine on a test basis whether or not a cooperative education program in industrial accounting would be of value to the student, to the employer, and to the university. From the standpoint of the student, it was thought that five possible benefits might accrue. He would:

1. Learn some of the practical aspects of industrial accounting.
2. Be more likely to know before he graduated if he would be interested in embarking on a career in industrial acounting.
3. Be able to choose his courses more wisely upon his return to school from the internship assignment, because of experience and maturity gained during the off-campus period.
4. Recognize the importance of gaining proficiency in related nonaccounting skills, such as report writing, preparation of charts and comparisons, effective speaking, appearance, etc.
5. Establish a possible job contact if he desired to return to the employ of the organization for which he worked during the internship period, provided the organization was favorably impressed with his work and potentialities.

From the standpoint of the employing company, certain other advantages were envisioned. The program would:

1. Give valuable training experiences in connection with the students, which could be used to improve the employer's own in-plant training programs.
2. Facilitate the task of recruiting junior executive trainees for jobs which require accounting skill.
3. Provide the opportunity to train the potential employee exactly as desired, so that the internee would learn the shop nomenclature of the particular business, its customers, and specific problems. Recruits could be obtained from internees, substantially lowering the possibility of making poor choices.
4. Stimulate supervisory personnel to review the duties of their departments in order to be able to adequately instruct the internees.

From the standpoint of the university, a cooperative program of this nature should prove of value in that:

1. It would assist the university in recognizing the nature of the training employers desire in the men they hire. The faculty would learn of the deficiencies found in performances of the students and could consider additions or changes in curricula to meet these deficiencies.
2. Programs of this type should assist in placing graduates where they will be best fitted.
3. This type of cooperative education frequently makes available case study material for research on the part of graduate students and faculty.

Selection of Student Internees

The faculty of the School of Business submitted to the cooperating company a list of fourteen students who had exhibited an interest in a program of this nature and whose scholastic average ranked in the highest quarter of their class. For the purposes of this program, it was decided to choose students who were completing their sophomore year in the School of Business. As these men were to spend the first internship period in factory accounting activities, it was thought that a knowledge of beginning accounting and elementary cost accounting would be adequate. Also, students who had two years of college yet to complete were considered as the ones who would benefit most by internship training, as they would be able to adjust their remaining college work in the light of the practical knowledge accumulated during the training period.

These fourteen students were interviewed on the campus by a representative of the personnel department and a representative of the accounting department of the employer. These representatives reviewed the students' academic records in detail, and conferred with the faculty members to obtain opinions of each student's possibilities. They also had available aptitude examinations showing the applicants' mental maturity, proficiency in English, and indicators of vocational aptitudes for various fields. With this information at their disposal, internship job offers were made.

The men selected were expected to work under the same conditions as all other staff members in the department to which they were assigned and were to be paid a salary commensurate with that paid to other people doing the same level of work. In addition to the pay received from the employer, the students were to be granted three hours' university credit upon completion of their internship period and upon the satisfactory completion of research papers and examinations which were to be administered and graded jointly by the employer and a representative of the university.

Internship Period and Area of Experience

A course of study for the three months' period was planned jointly by the company and the university. A specific area of factory accounting—in this case payrolls—was selected. It was decided that the students should perform the clerical and accounting work necessary to:

A. *Hourly payroll preparation:*

1. Timekeeping and use of efficiency book control.
2. Rate file.
3. Social security records.
4. Deductions.
5. Hourly payroll amounts.
6. Payroll earnings register.
7. Payroll check register journal.

B. *Distributing the payroll, including:*

1. Use of time tickets and efficiency book control.
2. Development of hourly rate and the forms used.
3. Preparation of the journal.

C. *Correlation of labor hours and pieces produced:*

1. Routings
2. Move orders.
3. Production record and group credit report.
4. Efficiency book control.
5. Efficiency reports.

D. *Development of standard unit labor cost.*

Having decided upon this work program, it was necessary to keep in mind that the work to be performed by the students must

be of value in assisting them to learn industrial accounting and also must be of sufficient value to the employer to justify the expenditure of salary to have it performed. In a program of this nature, these aims must always be recognized and synchronized.

Report Projects

In addition to the work performed during regular hours, the student was assigned report projects by the university, to assist him in becoming generally familiar with the business of the employer and with the operations performed in the manufacture of its product. The following outline indicates the character of the reports:

Report No. 1.
Drawing of plant showing:

Location of departments.
Name of each department.
Type and number of machines.
Number of people, by shift, by sex.
Flow of the product through the plants.

Report No. 2.
Knowledge of the products:

What unit or units does the plant produce?
What are the characteristics of the unit with respect to size, shape, weight, and operation?
How is the product ultimately used?
What parts and subassemblies go to make up the unit?
What are the approximate quantities of basic materials such as copper, etc., necessary?
How many hours are required to make a complete unit?
What is the ratio of punch press labor to assembly labor?

Report No. 3.
Activities of the accounting department:

The purpose of the accounting function.
Organization of the department.
Breakdown of the department into sections, supported by a chart of the department.
Discussion covering the interdepartmental relationships for effective performance of the accounting function.

Report No. 4.
Written examination designed to:

Determine to what extent the students were able to solve the day-to-day problems of time checking.
Determine to what extent the students had learned the manufacturing procedures.
Determine the degree of proficiency with which the students were able to apply the theoretical training received in the university to the practical problems.
Provide the opportunity for the student to display his basic ability.

This side of the program was instituted with the thought that no individual can be of great value or can understand much about the accounting phase of the business unless he thoroughly understands its basic organization and the problems faced by management in the administration of the sales, production, finance, and the personnel of the firm.

In making the report assignments, it was intended that the research and study load placed on the student would be comparable to the requirements that normally would be expected from a student on the campus in a three-hour course.

Supervision and Instruction During Training Period

To supplement the knowledge which the student would of necessity acquire by performing the work in the factory accounting activities of the employer and in studying and completing the projects assigned, the employer made it a part of the responsibilities of the immediate supervisors, in those departments in which the students were employed, to define specifically the steps involved in each accounting procedure performed, discuss with the students the accounting principles and audit functions underlying each of the procedures, and to explain the relationship of previously performed operations to succeeding operations.

It was also deemed necessary that the students become acquainted with the supervisory personnel of the employer, both within the accounting department and in other departments with which contacts were necessary in the process of doing the accounting job. A very important part of the development program hinged upon discussion resulting from a general counseling program. The subjects discussed in these impromptu meetings consisted primarily of minor difficulties encountered by the students in acquainting themselves with the many aspects of their work assignment.

The supervision of the students was two-fold in nature. The specific assignments which had been established for trainees were put into effect by the immediate supervisor in each department. The progress of the students was reviewed weekly by the general supervisory group of the accounting department. In order to measure more accurately and define more specifically the progress or lack of progress with respect to the general objective, the course of study for the work as a whole was divided into four major parts. Each of these four parts was subdivided in order to set out clearly each important step necessary to understanding of the work

assignment. A rather detailed listing resulted. Each of the items incorporated in this listing was rated according to code. By means of these codes it was possible to evaluate the degree of proficiency reached by the students in their work assignment. The general progress of the program was reviewed by the university through a weekly report submitted by each of the students.

Evaluation of Results

In summarizing the internship experience, certain conclusions were reached. The students obtained practical experience in performing accounting work. Each of them commented on a new awareness of the amount of detail records that need be kept in factory accounting and on the problems of organization in collecting and analyzing cost accounting information. Of the students who participated in this experiment, one has definitely decided that he desires to work in industrial accounting. A second has indicated a desire to work in public accounting before making a final decision. Others have had still different reactions. These particular students have been more discriminating in choosing courses since participating in the internship program.

In conducting this program, the company has attempted to be more specific than heretofore in its instructions relating to each job, being sure to make clear the accounting and auditing functions governing the procedures. Company management feels that the educational procedure embodied in the program will materially assist in providing a source of new employees who may develop into a junior type of executive more rapidly than employees obtained by other means. The company also found that participation in this project served as a refresher course to the members of the supervisory group.

From the standpoint of the university, the program brought to the attention of the faculty certain areas in which its course offerings should be made more complete. For example, it was readily recognized that additional instruction in such basic engineering subjects as blueprint reading, drafting, etc., was desirable. The program likewise emphasized the well-known fact that college graduates are deficient in their use of English, both written and spoken, and in the technique of preparing charts, writing reports, etc. On the over-all picture, it became clear that an internship program assists materially the function of the university in placing its graduates where they will be happy and able to work effectively.

SEVENTEEN YEARS OF MULTIPLE MANAGEMENT

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Much of the industrial accountant's attention is necessarily centered on organizational relationships. Inevitably an alert personnel, having effective channels of intercommunication, is cost and methods conscious and therefore easier to work with. The present article reports on the auxiliary system of company organization known as "multiple management," involving the use of a junior board of directors (as well as similar groups for factory, sales, etc.), which has yielded satisfactory results in the company whose experience the article reflects.

IT has been the accomplishments of the American form of capitalism that have provided us with many things we consider essential today but which were unavailable before the era of large-scale production. Neither Government nor labor nor any organized groups have been responsible for our progress. It has been the ability of business management to put theory into practice that has placed the fruits of science and invention within monetary reach of the average man. However, in a fundamental sense, it is something still further that has made these things possible. In my opinion, they became possible because consideration was given to our responsibility to protect the dignity of the individual or the "human equation." The recognition and maintenance of this dignity of man is the only way to inspire individuals to contribute to profits, and not only to profits but to making this a better world in which to live.

For a New Start in Business Relationships

Many of us have forgotten that the application of the "human equation" in our daily routine is the guarantee of our rights and freedoms, essentials to the maintenance of healthy free enterprise. We have got to reinstitute in our business life the principles and practice of regard for the welfare of our fellow man. The enthusiasm and direction has got to come from the top, from the leaders of the business, before others will follow. There never was a better time than the present for management to take a fresh look at its industrial relations practices and to check them against new and

improved techniques. We all need to look forward to a new horizon of better employer-employee cooperation which will help assure greater production, additional jobs, and more security of employment. Each of us should start to act so that the law of our life may well become the law of all mankind.

Employers must operate their businesses unselfishly, looking to the over-all good of the entire operation. It is only by virtue of unselfish thinking and consequent unselfish action that we can establish our modern business structure on a firm foundation with a greater return and protection for all, as opposed to a selfish policy which ultimately leads to misunderstanding, strikes, and anger.

Time Breaks Machines but Builds Men

To my mind, a good first step is to place men ahead of machines in our business thinking. In our company, we evaluate all potential executive talent more carefully than we evaluate a fifty-thousand-dollar machine. We feel that a leader for the future must be prepared by experience in the present, while a machine purchased today may be discarded after a brief interval because of deterioration or improved inventions. Experience builds a man while deterioration and use takes a toll of all machinery, and a man has the capacity to build a better machine or let it remain idle. That is why we put a price on each prospective executive so that we will not overlook our fifty-thousand-dollar human machines. It then becomes our responsibility to see that these men are trained and used to the maximum of their individual capacities. There are millions of dollars of untapped skill in American industry, all because our science of human relations has not kept pace with our material scientific achievements. It is imperative that we realize that human relations is a study that will bring equal and more lasting developments for the future welfare of our nation.

Think for a moment what sound human relations policies can mean to this country, its industry, its labor, and its government. There would be a minimum of strikes, a maximum of production, fewer business failures, and our taxes could be lower—all because of man's thinking. This field is an unexploited gold mine beneath our feet and this gold mine ultimately may be the most secure starting point for a better understanding of nations and for a lasting peace. Therefore, the most urgent duty of every business executive today is to make himself an expert in human relationships. Above

and beyond the cold factual "know how" of machines, finances, selling, and merchandising, which he has always considered his province, tomorrow's top man must be familiar with the minds of the people associated with him in order to anticipate their needs and desires and to prevent strife and discord. He must be able to deal with all types of people, not just his own "clique."

Inception of the Multiple Management Plan

To my mind there is no better way to present anything than by an explanation of an actual experience. At McCormick & Company, we do not speak from special knowledge but we have delved into the subject of human relations in business, possibly more seriously than any other firm in the country. In our effort to find some of the solutions to industrial personnel problems, we have reached certain definite conclusions. We feel that back-tracking on yesterday and endeavoring to correct the errors of that day is unimportant, but we do feel that to do something constructive today for the future is most important. We can offer only a few factual suggestions based entirely on our past seventeen years of thinking in terms of harmony in business, of cooperation with labor, and increased production through participation in management. Perhaps these are only general human principles, known originally to everyone but soon forgotten by overly-ambitious men.

At McCormick's, the first attempt to solve some of the problems of creating greater individual initiative was made in 1932 with the installation of our multiple management plan by our President and Chairman of the board, Charles P. McCormick. It was an attempt, soon to prove completely successful, to bridge our chasms with the aid of subordinate management boards which bring together all the ideas of the thinking people in the organization for the betterment of the business as a whole and the increased welfare of the people in it. Multiple management extends the opportunity of participation in the affairs of the company directly and actively to every thinking employee at the supervisory level and above. It provides for boards of directors made up of men from the office, plant, and sales organization, men who are on their way up, to supplement the senior board of top-management men.

The Junior Board of Directors and the Factory Board

In 1932, we began with a single junior board of directors. We selected seventeen men—assistant department heads, accountants,

junior executives, etc.—whom we considered to be the best prospects for future leadership and told them that they were to be given direct participation in management in their own group, operating independently of the senior board and the line organization. These men were told to elect their own chairman and secretary, set up their own schedule of meetings, and draw up their own by-laws. They were given the right to discuss anything in the business which interested them. They were assured that top management would not be present to look over their shoulders in the meetings and that their discussions would be free discussions without "top-side" interference. They were given suggested projects and topics, as a starter only, to provide an idea of the sort of subject matter on which the company could use their thinking.

There were two practical and realistic brakes put on this group which have not interfered with their free action but have given the business every protection any business wants. They were told, first, that every recommendation from their board must be unanimous. The instruction was, in substance, that if an original idea cannot be sold to the entire group around the table, it should be revised and amended so that the finished idea is thoroughly thought out and sound and commands the approval of all. Secondly, they were told that their recommendations would not go into final operation in the company until the president or the senior board of directors had approved them.

A factory board also was appointed at the beginning of the plan and operates in much the same manner as the junior board. It holds regular meetings and the members discuss matters of production, shipping, and warehousing—things with which they are concerned in their daily jobs. Many recommendations are made for improvement of plant procedures and techniques.

During the first five years, 2,109 unanimous recommendations came out of the junior board and the factory board. Of this number of resolutions, only six were turned down completely. This meant that 2,103 fresh ideas found their way into company operations and policies. Since ideas are the lifeblood of business, the business prospered from this harnessing of the potential creative thought of alert, aggressive, middle-management men.

Sales Boards and the Consumer Board

The sales board of directors was a logical further development at McCormick's because the business is divided into three parts—

office, factory, and sales. The sales board is made up of men in the sales organization. Since they are scattered from Maine to California, this board presented a special problem which was solved by arranging for meetings lasting a week and taking place twice a year. Between meetings the members carry on their work through committees by correspondence.

We finally needed a second board for the sales organization. Since the end of the war our bulk and institutional division has grown considerably. This division caters to manufacturers, hotels, hospitals, schools, restaurants, etc., an entirely different class of trade than that contacted by our principal sales force. As the problems of these two selling groups are entirely different, we have set up the institutional sales board of directors which operates similarly to the board previously mentioned but deals with its own area.

There also is a consumer board—of a little different type because composed of customers—with a membership of women, which makes recommendations on products from the standpoint of recipes, packaging, advertising, etc.

A Working Directorship of Fifty Members

No member of the senior board of directors (which corresponds to the board of directors of the average corporation) may serve on the junior, factory, or sales boards or attend subordinate board meetings except by invitation. Thus, instead of the usual half dozen or dozen people active in management on a board of directors, McCormick & Company has over fifty people serving as directors of the company. Their ideas are brought forth in free discussion and their management responsibilities supplement, but do not replace, their regular duties in their departments as parts of the line organization of the company.

Although the members of the original junior, factory, and sales boards were named by the president, the by-laws of each provided that members of succeeding boards should be selected by certain of the board members in accordance with a unique system. Every six months each junior board member, for example, rates every other member except himself on a chart which provides points for each of the following executive qualifications: human relations insight, vision, initiative, judgment, cooperativeness, and poise. The six men who rate highest become the membership committee and choose the remainder of the board for the next term, considering every potential executive in the company as eligible. The three men

who rate lowest are dropped from the board, but are told the reasons why by the membership committee and are assured that if their points of weakness are improved, there is a good chance of their being selected to return to the board six months later.

Maintaining of Worker Morale and Effectiveness

Management has been brought close to McCormick workers by this series of boards. A factory board member communicates to workers some of the problems and difficulties facing top management and the workers of the business, because he learns about them in board meetings. In the same fashion, workers communicate to board members their feelings and wishes. They are close enough to them to speak freely. Therefore, their suggestions and their requests are passed along rapidly in the very next junior or factory or sales board meeting and come up to management quickly.

In days of labor strife and turmoil, it is pleasant to be able to report that there have not only been no work stoppages at McCormick & Company in these seventeen years, but also that there have been no whispers of labor discord, no petitions from employees, no demands for changes in policy—nothing but harmony. The reason is that management is working in the interests of the people it employs and is close enough to them so that employee wishes and requests are put into effect as company policies by board action before they ever reach the demand stage. In other words, management takes the initiative in human relations.

This has brought about an invaluable spirit and morale. Our employee turnover is three per cent to five per cent in normal peacetime years. Unexcused absenteeism in wartime was always less than one per cent. Employee wages are the highest in our industry in our area and are supplemented by profit-sharing bonuses plus a program of benefits, including a company-paid pension plan, group insurance, sick benefits, complete medical service, and so on. We have stabilized employment. We have found that people working in business appreciate these benefits and reciprocate by giving their best. In addition to avoiding the plague of work stoppages and slowdowns, we have found that our people have maintained efficient productivity and that they will even increase it when called upon for special effort over a given period in the interests of building up a lagging profit. They have a direct incentive in the form of bonuses which are paid in proportion to profit earned.

Talent Resources of Middle Management

The middle management group has been accorded recognition through its eligibility to serve on boards. In this way, it has become definitely a part of the management organization. For example, there is no issue of whether a foreman is management or not. Men who otherwise would have little opportunity to display over-all management ability in their regular departmental jobs get a chance in board discussions and meetings to show what they can do in respect of management contributions for the entire business. We have found that this discovery of talent and training of future leadership is a valuable by-product to supplement the employee morale and the idea-producing values of the boards to the company.

However, I think the important result is that workers have increased earnings, management has received a direct return in the form of increased profits, capital (meaning stockholders) has received a direct return in the form of increased dividends, and the customer and consumer have benefitted by service, quality products, and cheaper prices. This is the record of multiple management. Our seventeen years of experience, and reports from several hundred other companies which have adapted multiple management to their organizations, prove by results that it pays for management to take the initiative in better human relations.

Harmony Is Efficiency

We humbly contribute this experience in the vast field of human relations as our small share toward a better understanding among the men and women who make up the fabric of business in America. Our country is better off in a material way than any other in all the world. We have only to clear the air of doubt and suspicion and get on with the job ahead. We at McCormick believe the means of solving the problems of the day are right within our grasp, if only we will open our eyes and deal with them. Multiple management may, after all, become a small candle in the darkness of labor strife that may encourage others to light many more to repel this darkness.

Through education and team play, peace in industry *can* be won. During the recent war it was the continuing and unrelenting team play of the civilian, the Government, and the military that won the war. All could not be at the front but all could play a part in winning the victory. Government *can* learn to be a servant, management a trustee, and labor a cooperative productive ally.

A Sales Compensation Plan to Stimulate Sales in Profitable Products

Just as we place foremen, department heads, and individuals on incentives for "beating" the budget or standard, so should we place the salesmen on an incentive which will accomplish the most for himself and the company. A successful salesman, from the individual standpoint, is one who makes the most in commissions. However, from the company standpoint, a successful salesman is one who sells the most plant capacity in terms of sales which net the most in gross profit per sales dollar. It is obvious that the sales compensation plan must be coordinated with these two factors if it is to be successful in operation. Let us examine the ordinary sales compensation plan in force today, then compare it with a sales compensation plan geared to accomplish these objectives.

The Bone Company makes three classifications of products known as Products A, B, and C. As indicated below, a straight ten per cent commission on sales value of items sold is paid in each case. We might have results something like the following:

	Product			
	A	B	C	Total
Units sold	50M	20M	15M	
Price	$4	$8.30	$6	
Sales	$200,000	$166,000	$90,000	$456,000
Cost of sales at standard	150,000	96,000	54,000	$300,000
Gross profit				
Amount	$ 50,000	$ 70,000	$36,000	$156,000
Rate	25%	42%	40%	
Unit	$1	$3.50	$2.40	
Commissions				
Amount	$20,000	$16,600	$ 9,000	$ 45,600
Rate	10%	10%	10%	
Gross profit after commissions	$30,000	$53,400	$27,000	$110,400
Capacity utilized				
Unit hours	.4	1.3	.8	
Total hours	20M	26M	12M	58M

In analyzing this type of operation it is easy to understand why Product A sold so many units. First, there is no special incentive for the salesman to sell Products B or C as the commission rate is the same for all three products and, second, Product A is priced at a low gross profit, either because of competition or because it is a marginal item which must be carried so that the line is complete. It may also be an easier item to sell than the other items. However, it is a low profit producer and does not contribute much toward keeping a plant working at or near capacity.

Let us change our remuneration plan for the salesman—without changing sales dollars—so that emphasis is placed on gross profit dollars, production hours, and higher commissions. Instead of paying a straight ten per cent sales commission on the sales dollar, the plan may be adjusted so that attention is directed to the products which are most desirable to sell from a gross profit and capacity standpoint, with an additional premium for

volume on items selected for these purposes. In this case, Product A is a marginal product necessary only to round out the line and some sales will be made without any sales effort. The commission on this item may well be reduced from ten per cent to five per cent. Product B is highly desirable because it produces the most gross profit and makes more work for the plant. The commission on this may be increased from ten per cent to twelve per cent for the first 25,000 units sold and for all sales over 25,000 units a fifteen per cent commission may be paid. Product C is close to the same class as Product B but not quite as good. However, the basic commission should be adjusted upward to twelve per cent for the first 15,000 units and fourteen for all sales over this quantity.

With such a plan as this in effect and total sales dollar volume remaining unchanged at $456,000, our unit sales might be changed as follows:

	Product A	Product B	Product C	Total
Units sold	21¼M	30M	20M	
Price	$4	$8.30	$6	
Sales	$87,000	$249,000	$120,000	$456,000
Cost of sales at standard	62,250	144,000	72,000	281,250
Gross profit				
Amount	$21,750	$105,000	$ 48,000	$174,750
Rate	25%	42%	40%	
Unit	$1	$3.50	$2.40	
Commissions				
Amount	$ 4,350	$ 31,125	$ 15,000	$ 50,475
Rate	5%	12% & 15%	12% & 14%	
Gross profit after commissions	$17,400	$ 73,875	$ 33,000	$124,275
Capacity utilized				
Unit hours	.4	1.3	.8	
Total hours	8.7M	39M	16M	63.7M

A comparative profit and loss statement drawn from the above figures for the original and revised plans clearly shows the effect of the change:

	Original plan		Revised plan		Per cent increase
Sales	$456,000	100.0%	$456,000	100.0%	
Cost of sales	300,000	65.8	281,250	61.7	
Gross profit before commissions	$156,000	34.2%	$174,750	38.3%	12.0%
Commissions	45,600	10.0	50,475	11.1	11.
Gross profit after commissions	$110,400	24.2%	$124,275	27.2%	11.3%
Plant Capacity Sold	58,000 Hours		63,700 Hours		11%

Careful analysis reveals that gross profits have increased 11.3 per cent over the previous gross profit, an increase equal to approximately three per cent of sales dollars and effecting a like increase in net profit before Federal income taxes. Also, commissions paid have increased eleven per cent and plant capacity or total hours of production increased a like amount.

It would appear from this statement that gross profit after commissions has increased from $110,400 to $124,275 or an increase of $13,875. However, the net increase is actually more than this figure because of the increased absorption of the fixed amount of burden (volume variance not included in cost of sales as shown). In checking our department budgets, we find that the burden cost for each product is divided as follows:

	Total burden	Fixed burden	Variable burden
Product A	$1.50	$ .50	$1.00
Product B	2.70	1.00	1.70
Product C	2.10	.70	1.40

On these figures the amount of fixed or time burden absorbed under each plan can be computed and compared:

		Original Plan		Revised Plan	
	Fixed burden	Units sold	Burden absorbed	Units sold	Burden absorbed
Product A	$ .50	50,000	$25,000	21,750	$10,875
Product B	1.00	20,000	20,000	30,000	30,000
Product C	.70	15,000	10,500	20,000	14,000
			$45,500		$54,875

Therefore, not only was the gross profit increased by the change in sales mix with a standard cost per unit but, in addition, $9,375 ($54,875-$45,500) more in fixed burden was absorbed in the units sold. This is a direct result of the increased use of plant capacity. In other words, gross profit has increased, not just by the $13,875 shown above but by this further amount, or an aggregate of $23,250, which is 5.1 per cent of sales.

A sales compensation plan must direct the effort of the salesman to those products which result in greater use of plant capacity, more gross profits, and increased sales commissions. Services and facilities are the only things that any company has to sell, and the more of these that can be sold the greater the profits will be, resulting in a strong financial position which will permit expansion and growth. The control of the sales mix is an important factor in keeping profits high.

Contributed by K. R. RICKEY, *Chicago Chapter*

FIXED ASSET PROCEDURE FROM REQUISITION TO RETIREMENT

by JOHN F. GAITHER,

Chief Accountant, Seeger Refrigerator Co., Evansville, Ind.

In very few companies is the management or the accounting staff thoroughly satisfied with the accounting procedures for fixed assets. The author of this paper, who reports that his company's procedures in this area require frequent adjustment to conditions, offers a rounded statement of practices followed. The point of departure for description of detail is the statement that "the prerequisite to proper recording of fixed assets is proper classification."

THIS paper is intended to set forth in some detail the methods and controls set up by one company to account for their capital asset investment. The distinctive characteristic of fixed assets as compared with inventories, aside from the question of life expectancy, is the manner of application to the production operation of the plant. Buildings and equipment give up their services throughout their life and, although their physical life is affected by use, no actual material is lost to the product which is produced. This is quite unlike inventories and supplies in which the actual material is used in manufacturing the finished article. Because of this characteristic of living on in physical form despite loss of utility, the accounting for capital assets tends to become complex and the treatment accorded them extremely varied. The treatment of fixed assets on the books is further complicated by the regulations of the Treasury Department and by the Securities and Exchange Commission, necessitating more adequate records and procedures for securing effective control.

Purposes To Be Served by Fixed Asset Records

The fixed asset records should answer at least a three-fold need:

1. The proper determination of depreciation charges and dollar value of capital investment.
2. A proper basis for income tax computation of depreciation and gain or loss on disposition.
3. A control of capital expenditures for operating purposes.

Equipment Class

Estimated Life Yrs.

Property No.

DESCRIPTION

Manufacturer

Model No.

Serial No.

Type

Depreciation Record

Annual Rate ____%

or ____

Per Month

Year	Amount

Location

Date	Plant	Bldg.	Floor	Dept.	Account

Purchased ☐ New or ☐ Used — If Used—State Age

Purchase Data	(1)	(2)	(3)	(4)	TOTAL
Supplier					
Req. No.					
P.O. or W.O. No.					
Invoice Date					
Invoice Amount					
Transportation					
Installation M					
B-No. L					

DISPOSITION

Date ____

Invoice No. ____

Sold to (Scrapped) ____

TOTAL COST

Depreciation To Date

Book Value

Sale Price

(A) Loss or Gain on Disposition

(A) Journal Entry ____ No. ____ Month ____ Year By ____ Name

SERGER REFRIGERATOR COMPANY

PROPERTY RECORD

EXHIBIT 1

There is no doubt that there are literally hundreds of controls and uses that proper records will furnish but these appear to constitute the three basic needs. Records may also be somewhat helpful for evaluation of fixed assets for insurance requirements, but this is true only for recent acquisitions. It is possible and perhaps practical to incorporate on the ledger records the determination of replacement costs of plant facilities to provide for the accruing of depreciation on the replacement figures for special purposes and yet preserve recorded cost figures. Our company does not make use of replacement cost depreciation, nor do we have any present intention of doing so. Instead we base our fixed asset values for insurance and other purposes on plant appraisals made by an independent appraisal company and maintain our plant ledger on a cost basis.

Classification; Identification; Standard Practice

The prerequisite to proper recording of fixed assets is proper classification. Most industrial balance sheets show fixed assets under the general headings of building, machinery and equipment, etc., but a more complete breakdown is necessary if the three-fold function of the records is to be carried out, especially since the treasury department places the burden of proof on the taxpayer when it comes to substantiating depreciation computations and values of assets charged off. It is necessary, therefore, that the records show *at least* the following information:

1. Description of the equipment, manufacturer, model, and serial.
2. Location of equipment.
3. Basic cost of equipment, installation cost, and freight cost.
4. Additional expenditures or major improvements.
5. Annual depreciation charges.
6. Disposition information.

We feel that our system provides these basic needs but we also recognize that it is far from perfect and we are changing it frequently to meet varying internal needs and conditions. Our particular situation is somewhat complicated because we have on our books from earlier years old equipment on which no individual records are set up. These items are carried in a composite account and depreciated at a composite rate. Since the war, however, we

have maintained individual records which we hope will in time provide us with a fixed asset ledger in complete detail.

The establishment and operation of a system naturally entail corresponding organization and responsibility on the part of all divisions. We felt it desirable to place the basic responsibility for maintenance of the records in the hands of the general accounting department, property section, with an accountant in charge on a supervisory level. The section then designed the required form of property ledger illustrated in Exhibit 1. The next basic step was to prepare a standard practice in written form relating to procurement and disposition of buildings and equipment, so that departmental responsibility could be established at all points of fixed asset handling.

Initiating the Purchase and Placing the Order

The production engineering department initiates all requisitions for the purchase of new, used, or replacement machinery and equipment and determines the need for new buildings and real estate. These needs are based, of course, on the over-all long-range planning of top management. The requisition must include:

1. A complete description of the equipment needed.
2. Proposed location of equipment.
3. Type of operation to be performed.
4. Capital budget reference.
5. Property number.

The production engineering department is assigned a block of property numbers and an individual number is assigned to the requisition on all basic machines. Supplemental parts are not assigned new numbers. All such requisitions issued are approved by the works manager, general manager, and treasurer before being forwarded to the purchasing department.

Upon receipt of the approved requisition the purchasing department prepares a formal purchase order to the specified source. If the equipment is to be purchased directly from the manufacturer, the purchasing department obtains a property number tag from accounting to be affixed to the machine before shipment.

Installation of the Equipment

Promptly upon receipt of the machine and after identification with the particular purchase order, the receiving department noti-

fied the plant layout department. The machine is then delivered to a location indicated on the "equipment move order" initiated by plant layout. This form is then sent to the accounting department. The maintenance department is charged with the responsibility of actually moving and installing equipment and also initiating requisitions for the purchase of spare motors and replacement parts. The standards department is responsible for the issuance of work orders to which all costs incurred incidental to the installation of capital equipment are charged.

Accounting Department Clearance; Setting Up of Record Card

The accounting department approves all requisitions for the purchase of capital equipment and also reviews all requisitions for expense items and maintenance of capital equipment to determine if any should properly be capitalized. This department is also charged with the responsibility of recommending disapproval of capital purchases if the dollar value exceeds the total capital budget appropriation. Such aggregate annual appropriations vary from normal replacement requirements to long-range programs for building and plant modernization. The primary accounting function is to furnish significant information to top management respecting the status of the capital outlay budget and it is necessary that clear, concise, up-to-date reports be issued to help management in its decisions. These reports are prepared monthly, reporting requisitions issued against appropriations, as well as giving a detailed list of equipment received during the year and installed.

After the equipment is received and the accounting department is notified of the location and installation costs, the individual record card (Exhibit 1) is created from the invoice, showing all pertinent details as to description, costs, etc. This card becomes part of the permanent record. At this point the accounting department consults the production engineering department for an estimate as to the useful economic life of the equipment. A check is also made with the Treasury Department depreciation tables, contained in Bulletin F, to determine the propriety of our estimate. Careful consideration is given to the hours the machine is to be worked, the special handling that may be accorded it, and the special job that it may be designed to perform. These factors must be carefully weighed to arrive at a factual economic life. This required information is recorded and the cards are filed by

1. Depreciation group.
2. Plants within depreciation groups.
3. Property numbers within plants.

(We are thinking now of preparing tabulating cards to serve for individual record cards to facilitate sorting, calculation of depreciation, etc., but these plans are still in the formative stage.)

All subsequent moves of equipment, major improvements or betterments, or other costs incurred in connection with any piece of property are reported to the accounting department through copies of requisitions, work orders, equipment move orders and, in some cases, by observation. Insurance records are kept up-to-date by reporting all acquisitions or removals to the appraisal company monthly. All insurance losses are then handled through the accounting division in cooperation with the production and administrative departments.

Initiating Dispositions—The Problem of Control

A factor which deserves special consideration and which is generally a weak spot in most systems is that of adequate accounting for dispositions. There is a tendency in most plants for the maintenance department to move small items of equipment or cannibalize them for maintenance purposes. This undoubtedly reduces paper work, is cost- and time-saving to a degree, but definitely does not facilitate accounting nor does it bear the sanction of the accounting department. We feel that our system is streamlined enough and the degree of cooperation among departments is high enough to hold such tendencies to a minmum. At any rate, proper accounting for removals becomes somewhat more difficult than the recording of acquisitions, except for items of major equipment.

Responsibility again falls on the shoulders of service departments in practically the same order as was followed in the acquisition of items. The production engineering department determines when a piece of equipment is no longer needed and requests the book value figures from the accounting department on the Valuation Report and Disposition Order (Exhibit 2). Upon receipt of this information the production engineering department makes the decision as to the advisability of replacing the equipment and, if replacement is decided upon, circulates the form for top management approvals. The form must give a detailed

SEEGER-EVANSVILLE
VALUATION REPORT AND DISPOSITION ORDER

Description .....
.....
.....
Purchased from..... Date.....
Mfg. serial No. ..... Seeger property No. .....
Reason for disposition (Explain in detail).....
.....
.....
.....
Salvageable items (if scrapped)

.....
Superintendent, Product Engineering

To: *Accounting Department*

Initial cost .....
Extras .....
Installation .....
Freight .....
Total .....
Depreciation res. .....
Book value .....

Remarks:

.....
Accountant—Property Section

.....
Chief Accountant

DISPOSITION ORDER

To: *Material Control*

Authorization to dispose of above item of equipment is granted.

....
Supt. Prod. Eng. Asst. Treas.

....
Works Mgr.

....
Gen'l Mgr.

To: *Accounting Dept.*

Date shipped .....
Invoice amount .....
Invoice No. .....

.....
Mgr. Material Control

ACCOUNTING USE

Journal entry No.....
Date .....

Book value $.....
Sales price $.....
Loss or gain $.....

.....
Chief Accountant

.....
Asst. Treasurer

EXHIBIT 2

reason for the disposition. At this time, the maintenance department is ordered to move the equipment to a special, wired-off area in the warehouse, which is under the jurisdiction of the accounting department. The approved form is then forwarded to the material control division.

Obtaining Bids

Upon receipt of the valuation report and disposition order, the material control division requests the purchasing department to obtain bids on the whole machine or, if the machine is to be scrapped, requests the scrap reclaim division to obtain scrap bids. At least three bids must be obtained. The disposition order is approved for the best bid. In some cases, the equipment may be transferred to another division plant for use there. For this reason, other divisions are always notified before outside bids are requested. The disposition report ultimately goes to the accounting department for the proper entries to be made.

The accounting department checks that equipment for which disposition has been decided upon is moved to the wired-off area as provided, and then initiates the move to the shipping floor or scrap reclaim shed as circumstances warrant. The property tags must be removed and forwarded to the department for destruction, since all accounting for property tags is also done by this section.

The necessary journal entries recording the sale or disposition are made and the loss or gain is computed. Complete detail is kept on these transactions for the annual audit and S.E.C. reports. The record cards are stamped appropriately and are held in a special file for examination.

Conclusion

It is recognized that there are many controversial points brought out in the handling here narrated and it is more than possible that the system lacks perfection in many respects. However, the procedure effects certain controls often lacking in the handling of fixed assets. It is essential that accountants continue to make strides toward perfection in order to assist management to make sound decisions. Any improvements an account makes in this direction serves his company to advantage. The complexities met in fixed asset accounting open a road for advancement and study which has hitherto been scarcely followed.

CONTROLLING MANUFACTURING EXPENSES THROUGH APPLIED FLEXIBLE BUDGETING

by AUSTIN F. MATTHEWS, JR.

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A review of the principles of flexible budget construction is included in this article in which the author directs primary attention to control of factory overhead as it may be related to departmental production and service units and so rendered a very concrete matter. Indirect labor, supplies, and other fixed, variable, and semivariable expenses are discussed.

ACTIVITIES for controlling manufacturing overhead are properly directed toward ascertaining:

1. What the overhead costs should be.
2. What the overhead costs have been.
3. The causes of differences.

Budgeting of Overhead Costs

In order to determine what the overhead costs should be, it is necessary to forecast the anticipated production volume for the coming fiscal period. This requires, first of all, the estimated amounts of sales of all the company's products.

Serviceability of Flexible Budgeting

The sales forecast constitutes a problem too broad to be treated in detail in this paper. It suffices for present purposes to say that the salesmen present their estimates of sales potentials, which are reviewed by the sales manager and passed on to the budget committee where they may be modified according to expected company policies, new developments in the field, general business conditions, etc. With this sales estimate established and converted into a budget of production, the problem of overhead estimates can begin.

Because the overhead forecast must be based on the expected volume of production, difficulties may arise later in analyzing differences between budgeted and actual overhead if the volume

of actual production for the period was larger or smaller than originally forecast. These difficulties may be overcome, however, by the use of a so-called flexible budget, which is a detailed forecast of overhead expenses at several different production levels, one of which can be expected to be reasonably close to the actual volume level. To facilitate these forecasts, all expenses must be classified according to their variability as fixed, variable, or semivariable. For practical purposes, fixed expenses are those which will not fluctuate even though the volume of production does, at least within reasonable limits. An example is the plant superintendent's salary. Variable expenses not only fluctuate if production fluctuates but do so in proportion to it. The semivariable expenses increase and decrease at a fixed rate as production increases and decreases, but not in direct proportion to the change.

Fixed, Variable, and Semivariable Expenses

Starting with the fixed expenses, a close scrutiny should be made of such items as insurance, depreciation, taxes, and supervision, with an attempt to determine where cuts can be made without interfering with the operation of the business. In most concerns, if the fixed expenses are energetically attacked, it will be found that certain items that are accepted as a matter of course could be easily eliminated. One company, for example, adopted the slogan, "The unfixing of fixed expenses," and made considerable reductions in this category. After these expenses have been cut to a minimum, they will fit readily into the construction of the flexible budget, since they will remain constant at all volume levels.

The only expenses that are truly variable in proportion to production are those that bear a definite relationship to the product itself, such as indirect materials, scrap, or spoilage. Here a thorough review of the production methods should be undertaken by competent men who are familiar with production, engineering, and mechanical problems. Improvements may be discovered in this examination which will not only reduce overhead costs but have other far-reaching effects, such as decreasing labor turnover, increasing the quality of the product, or shortening production time. Then, after these variable expenses have been reduced to a minimum allowance per unit of activity, they may be incorporated in the flexible budget simply by multiplying the unit allowance by the number of units that would be produced at the different volume levels.

The last classification of expense, the semivariables, offers the greatest difficulty because their variability is not in proportion to production. Moreover, the largest number of overhead items will fall into this class. There are two different methods commonly used to estimate the amounts of these expenses: (1) the detailed analysis and (2) the estimate in relation to some activity index. Since indirect labor is perhaps the most important semivariable expense, let us examine these two different methods of forecasting this item.

Detailed Budgeting of Semivariables: Indirect Labor

If the first plan is followed, the foreman of each department is asked to submit the number of indirect workers who would be required at the various levels of operating capacity. This foreman's estimate should be completely detailed, giving the name, clock number, occupation, and rate of pay, for every individual who is to be classed as an indirect worker, together with the expected number of hours each of these persons would work, at the various production levels.

This estimate should be reviewed by someone of higher authority. Then, in conference with the foreman and representatives of the personnel and engineering divisions, every job should be critically examined to determine that:

1. It is essential.
2. It is worth the anticipated payment.
3. The right person is on the job.
4. The most efficient method is used.

When this detailed study is finally completed, it should appear in a form similar to Exhibit 1. It should be noted that some indirect workers' costs are fixed, others are directly variable with production, and still others vary in a greater or lesser degree than production. In total, however, it will be found that indirect labor does not vary in direct proportion to the level of activity and therefore is a semivariable.

Scatter Chart Method Applied to Indirect Labor

Where it is not considered practical to prepare such a detailed estimate as that just illustrated, satisfactory results can usually be obtained by estimating the total indirect labor in relation to some base, such as direct labor costs, by means of a scatter chart sim-

Semivariable Expense Behavior--Indirect Labor
(Detailed Budget Method)

			Percentage of Capacity							
			60		70		80		90	
Employee	Position	Rate	Hours	Cost	Hours	Cost	Hours	Cost	Hours	Cost
J. Smith	Supervisor	$1.60	160	$ 288	160	$ 288	170	$ 315	180	$ 342
R. Williams	Trucker	.90	160	144	160	144	165	150	168	156
A. Roberts	Trucker	.90	160	144	160	144	160	144	160	144
B. Brown	Inspector	1.00	160	160	165	167	170	175	175	182
L. Reilly	Helper	1.00	160	160	176	182	198	205	214	223
P. White	Clerk	.75	160	120	160	120	160	120	160	120
Transfer or New Worker	Inspector	1.00	---	---	---	---	---	---	40	40
Totals			960	$1,016	981	$1,045	1,023	$1,109	1,097	$1,206

EXHIBIT 1

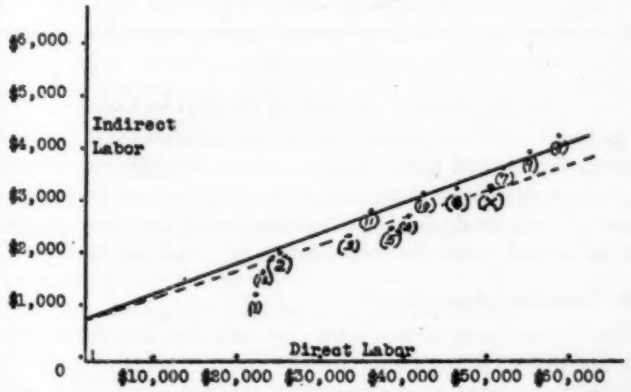
ilar to Exhibit 2. In order to fully understand this chart, some words of explanation are necessary. Using the results of the previous year (or years if thought advisable), a point is plotted for each month showing the amount of indirect labor on the vertical scale in relation to the total direct on the horizontal scale. For instance, January direct labor on the horizontal scale in the amount of $22,000 and indirect labor of $1,100 is plotted as point 1, and so on until all points are located. Then a line (solid line on Exhibit 2) is drawn at sight, which appears from the positions of the plotted points to represent the total indirect labor in relation to direct labor.

With this information, the fixed and variable portions of the expense can be distinguished. Since the line intercepts the vertical axis (when direct labor is zero) at a point equivalent to approximately $800, this amount is presumed to represent the fixed portion of indirect labor, the remainder being variable in a constant rate represented by the slope of the line. The chart indicates that at a production volume calling for $50,000 of direct labor, indirect labor would be about $3,500. Deducting the $800 of fixed expense leaves an amount of $2,700 of variable expense for $50,000 of direct labor, or 5.4 cents for each dollar.

If management decides that a fifteen per cent reduction in the variable portion is possible, the indirect labor expense for $50,000 of direct labor would be $3,095 ($2,700 less fifteen per cent plus $800), which is represented by point X. Connecting this point

with $800 on the vertical axis gives us the broken line which represents the new allowance for indirect labor throughout the various levels of activity. The estimated amount of indirect labor for any given level of direct labor can readily be estimated by erecting a perpendicular from the amount of direct labor on the horizontal scale to the indirect labor allowance line and, from the point of intersection, drawing a horizontal line to the indirect labor cost on the vertical scale. In practice, it is convenient to use graph paper.

Semivariable Expense Behavior--Indirect Labor
(Related to Direct Labor As a Base)



Last Year's Figures

	Month	Direct Labor	Indirect Labor
(1)	Jan.	$22,000	$1,100
(2)	Feb.	26,400	1,860
(3)	Mar.	32,900	2,325
(4)	Apr.	40,100	2,570
(5)	May	38,700	2,420
(6)	June	46,500	3,100
(7)	July	53,400	3,740
(8)	Aug.	58,600	4,200
(9)	Sept.	55,200	3,825
(10)	Oct.	41,000	2,880
(11)	Nov.	37,600	2,650
(12)	Dec.	25,100	1,600

EXHIBIT 2

Primary Standing Order for Supplies

Standing Order No. 666 — Expense: Supplies

Departments	JANUARY			FEBRUARY			TOTAL		
	Actual	Budget	Variance	Actual	Budget	Variance	Actual	Budget	Variance
Service:									
Planning									
Trucking									
Stockroom									
Payroll									
Supt. Office									
Production Depts:									
A									
B									
C									
D									
Total									

EXHIBIT 3

ACCUMULATION OF ACTUAL OVERHEAD COSTS

As this flexible budget will now include estimates at the different capacity levels of all fixed, variable, and semivariable expenses, the first phase of the overhead control project—the determination of what the overhead should be—is completed, and we are ready for the second phase, the accumulation of actual overhead costs.

The "Standing Order Sheets"

For the purposes of this paper, we may omit any discussion of the particular types of journals or vouchers used to record the overhead expenses in the books of original entry. Regardless of the form used for these records, all overhead items will be charged to the manufacturing expense control, which acts as a controlling account for a subsidiary manufacturing expense ledger composed of primary "standing order sheets" for individual expenses and secondary "standing order sheets" for individual departments, the two sets being in aggregate agreement with each other.

An example of a primary standing order is given in Exhibit 3. One of these forms is prepared for every overhead expense, displaying the amount of that expense broken down by the departments to be charged and providing columns for recording the budget amounts and actual amounts, and for determining variances. Exhibit 4 illustrates the type of secondary standing order

that would be prepared for each department. This classification shows the breakdown of the total expenses for each department under the headings of fixed, variable, and apportioned. Again columns are provided for a recording of both budgeted and actual expenditures and determination of variances. In summary, then, the actual overhead is recorded in the general books and, at the same time, is posted to the primary standing orders which show the total amount of each expense broken down by departments. Next, the information shown on the primary standing orders is reclassified on the secondary standing orders for the various departments.

Budget vs. Actual

Thus, after the service departments' costs have been reapportioned, the total actual overhead as shown by the general books has been classified both by type of expense and by departments. We are now ready to make a comparison between these actual amounts and the original budget estimates. This constitutes the last step of our control project outlined at the start of this paper.

Effecting Comparisons

Since a variable budget was drawn up for several capacity levels, the nearest estimate to the actual volume must first be selected.

Secondary Standing Order for a Production Department

Standing Order No. 1076 — Production Department A

Expenses	JANUARY			FEBRUARY			TOTAL		
	Actual	Budget	Variance	Actual	Budget	Variance	Actual	Budget	Variance
Fixed:									
Taxes.....									
Rent.....									
Depreciation....									
Variable:									
Power.....									
Indirect Labor..									
Service Dept:									
Personnel.....									
Planning.....									
Accounting.....									
Supt. Office....									
Building Serv...									
Total.....									

Exhibit 4

This is merely a matter of ascertaining the actual volume from the production records, either in production units, direct labor hours, or direct labor cost, depending on how the capacity level is measured. (It is probable, of course, that the actual level of operation will not be absolutely identical with any of the budgeted levels but, for practical budgeting purposes, this point can be overlooked, although note is taken of it in the variance analysis.) Then the budgeted estimates for the nearest volume level are posted to the primary and secondary standing orders to which the actual amounts have already been posted. By simple subtraction, the controllable variance for each item is determined.

When a complete budgetary system is in use, which requires a fixed overhead estimate at some volume level in order to prepare an estimated profit and loss statement, it is customary to analyze total variances into volume variances and controllable variances. The volume variance is in that case the difference between the budgeted overhead at the estimated capacity level and the budgeted overhead at the actual capacity level. Since this discussion is not concerned with estimating a definite overhead volume, we are considering only the difference between the actual expenses and the flexible budget for the budgeted volume level nearest to actual. This variance is called controllable because, the budgeted amounts having been adjusted to the volume level, any differences between the budget and the actual results should be within the control of the management. If the whole project is to result in the reduction of overhead, it is in respect to these controllable variances that careful cost analysis must be made.

Review of Variances with Foremen

Since the primary responsibility for these variances rests with departmental foremen, they should be presented with a report showing the variance amounts, with a request for explanations of major items. Finally, someone in a supervisory capacity should review the reports with the foremen and, where unusual expenditures appear, a thorough analysis should be made to ascertain and remedy the cause of such a situation.

In conclusion then, it appears that if such a project as this is thoroughly and systematically undertaken, a considerable reduction in overhead costs should result, in the ordinary instance—and not only for the present but for the future as well.

THE EFFECT OF SETUP TIME ON UNIT COSTS—A CASE STUDY

by ALBERT D. ALTER,

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Basing his material on the conditions in a spinning room—where the frames must remain idle while full bobbins are replaced by empty ones—the author studies the effect of change in "down" or setup time through specific examples, using data as to "doffing" time, doffing labor, and running time. Conclusions as to the more general applicability of the study are offered.

ONE of the oldest problems in manufacturing involves the relationship between increased production and the increase in direct and indirect charges against this production. There are four probabilities affecting the unit cost through an increase in production.

1. Total charges constant; cost per unit decreases
2. Total charges increase; cost per unit decreases
3. Total charges increase; cost per unit constant
4. Total charges increase; cost per unit increases

In most industries, increases in production over a current level would result in realization, in turn, of each of the four probabilities shown above at particular (but usually not known) volumes and it should be the concern of the cost department to disclose the fluctuation in the unit costs at indicated production levels.

It is a temptation, sometimes, to assume the first alternative, especially when increased production is effected within regular hours. This is often so, but the limits must be established. Where the machine hours scheduled per week remain at a constant level, the production and engineering departments are prone to attempt to increase production through economy in setup or change time. Although the rate of absorption of *fixed* charges would obviously be accelerated under such circumstances, it might prove valuable to make a detailed cost analysis to see to what extent such a decrease in setup time might increase the cost per unit of *variable* charges.

Doffing in Teams vs. One-Man, One-Machine Doffing

In a textile mill, the spinning room presents such a problem. After the spinning bobbins have been filled with yarn, the spinning frame must remain idle until the full bobbins are removed and replaced by empty bobbins. The frame cannot resume production until other minor duties are performed, such as "winding rail" and "piece breaks." This process of replacing the full bobbins is called "doffing."

In the mill providing the data for this presentation, the frames were situated in sets of ten, so that from one to ten doffers were required to service the entire ten frames. A time study had been taken and a standard of .0608 minutes for one doffer to doff one spindle was set with the usual allowances for personal time, fatigue, etc., to produce a 70 per cent work load. Each spinning frame studied had 272 spindles. Therefore, one doffer could doff one frame in 16.54 minutes (272 x .608). The following shows the time allowed to doff one frame with the indicated number of doffers:

No. of doffers	*Spindles per doffer*	*Doffing time*
1	272	16.54
2	136	8.27
3	91	5.51
4	68	4.14
5	54	3.31
6	45	2.76
7	39	2.36
8	34	2.07
9	30	1.84
10	27	1.65

On a certain type of yarn selected for consideration, the standard running time for each frame to fill the spinning bobbins had been set at 74.43 minutes. At the end of this time, each of the 272 bobbins were filled, giving a total production of 13.6 pounds of yarn from each frame. The costing rate with two doffers was $3.344 per frame hour ($1.310 variable; $2.034 non-variable). The problem then at hand was to schedule the doffing or setup time so that a minimum of running time was lost and to provide the least expensive doffer load to accomplish this purpose.

For instance, when two frames of one set stop simultaneously and two doffers are working as a team, there existed the belief

that placing one doffer on each frame would result in the least amount of lost running time. However, a simple analysis, based on the foregoing data, proved that it would be more efficient to place both doffers on one frame and allow the second frame to remain idle until the first was ready to resume production. It will be noted below that production is of the 13.6 lbs. of yarn, which has been mentioned, over the standard period of 74.43 minutes. The summary is as follows:

	*Case 1**		*Case 2***	
	Frame #1	*Frame #2*	*Frame #1*	*Frame #2*
Waiting to doff..	—	—	—	8.27 min.
Begin doff	10:00 a.m.	10:00 a.m.	10.00 a.m.	10:8.27 a.m.
Doffing time per table	16.54 min.	16:54 min.	8.27 min.	8.27 min.
Frame start	10:16.54 a.m.	10:16.54 a.m.	10:8.27 a.m.	10:16.54 a.m.
Running time	74.43 min.	74.43 min.	74.43 min.	74.43 min.
Frame stop	11:30.97 a.m.	11:30.97 a.m.	11:22.7 a.m.	11:30.97 a.m.
Elapsed time	91.37 min.	91.37 min.	83.10 min.	91.37 min.
Production	13.6 lbs.	13.6 lbs.	13.6 lbs.	13.6 lbs.
Cost per lb.***...	$.3728	$.3728	$.3390	$.3728

* Two doffers assigned, one to each frame.

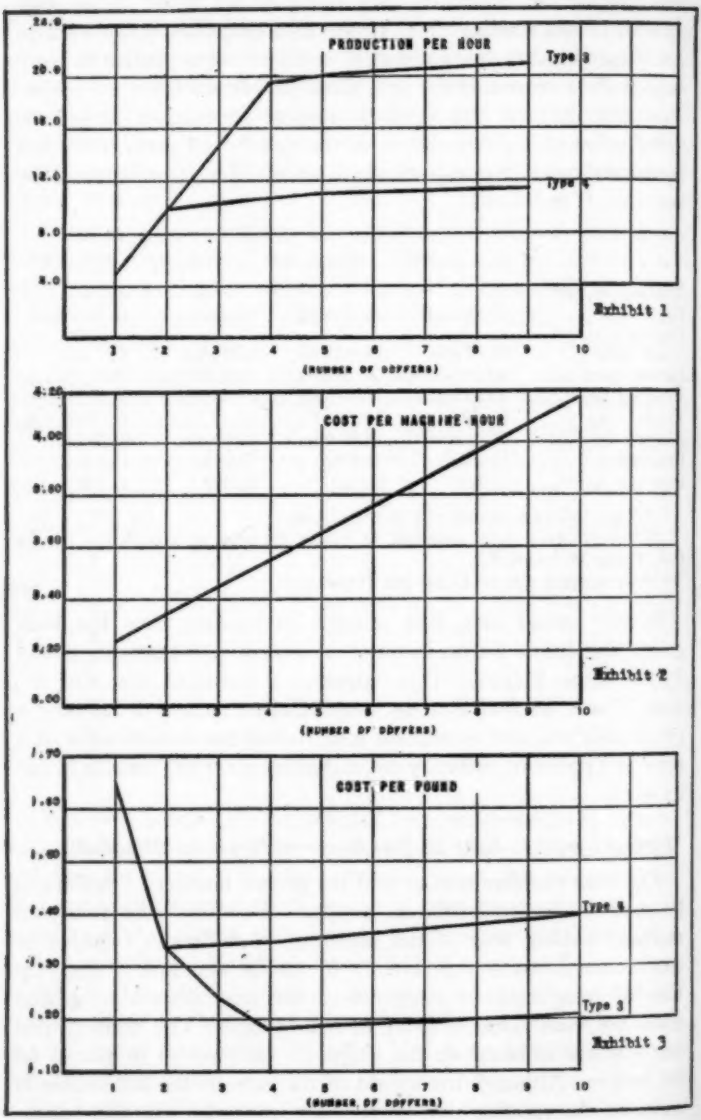
** Two doffers, both assigned to frame #1 and, at completion of the doff, begin on frame #2.

*** On costing rate of $3.344 per frame hour.

In the second case, 8.27 minutes in running time has been gained for frame #1 or, in terms of money, 3.38 cents per pound (3.728 minus $.3390). This represents a saving of over nine per cent. Thus, we find that the most efficient method from both a production and cost standpoint is in having the doffers work as a team and under no ordinary circumstances allow the team to divide its work.

"Perfect Cycle" to Keep Doffers Busy and Machines Attended

The next problem was to find the proper number of doffers to be used to give a minimum amount of doffers' idle time and machine waiting time. Since the team of doffers is required to service ten frames, a perfect cycle can be obtained if the stop time of each frame is staggered so that nine frames are doffed while the tenth frame is filling its 272 bobbins. The running time for a frame is based on the length of the yarn to be placed on the bobbin. Although the weight of the yarn on the full bobbin is constant, the running time would vary inversely with size (diameter) of the yarn.


PRODUCTION PER HOUR
Type B
Type A
Exhibit 1
(NUMBER OF DOFFERS)
COST PER MACHINE-HOUR
Exhibit 2
(NUMBER OF DOFFERS)
COST PER POUND
Type A
Type B
Exhibit 3
(NUMBER OF DOFFERS)

Using the following types of yarn with their corresponding running times as an example, the perfect doffing time is derived by dividing the running time by nine (number of frames minus one). Using this as a standard time to doff each frame, a perfect cycle is obtained and the doffers would never be idle while waiting to doff. The number of doffers required to produce this standard doffing time for these yarns can be determined from the table below:

Yarn type	*Running time*	*Doffing time* (1/9 running time)	*Number of doffers required* (at doffing time stated)
1	18.63	2.07	8
2	29.79	3.31	5
3	37.26	4.14	4
4	74.43	8.27	2

Still More Doffers MAY *Mean Lower Unit Cost*

It would seem that by deriving our perfect doffing cycle as above and determining the number of doffers needed to meet it, our problem might be solved. However, an analysis of the unit costs of using a varying number of doffers might prove that the ideal number of doffers to allow for no doffers' idle time, might not prove to be the ideal number of doffers on a cost per pound basis. The reduction in setup time through the addition of an extra doffer might result in enough of a gain in production so as to produce a lower unit cost. This saving will hold true in spite of the fact that the doffers will necessarily have idle time during each cycle to wait for each frame to run out. For example,

DATA: Type yarn: # 4 Running time: 74.43 minutes
Perfect cycle: 2 doffers

Number of doffers	*Doffing time*	*Costing rate per frame hour*	*Production per hour*	*Cost per pound*
1	16.54	$3.239	4.94	$.6557
2	8.27	3.344	9.87	.3388
3	5.51	3.449	10.21	.3378
4	4.14	3.554	10.39	.3421

Using the number of doffers indicated above, we find that by using one doffer we have 90.97 minutes of machine time lost

(time for one doffer to doff 10 frames minus the running time) while the frame is waiting to be doffed. When two doffers are utilized, the machine is always either running or being doffed and the doffers are also never idle. However, in using three doffers, we find that, by reducing the doffing time, we also reduce the unit cost, although three doffers would be idle 24.84 minutes, 74.43 — (9 x 5.51), on each cycle. This represents 33 per cent idle time for each doffer and, despite this situation, the cost per pound is lowered. By using four doffers, the doffers' idle time has increased to the extent that the increase in production does not warrant the added cost. Thus, three doffers always working as a team would give us the lowest possible unit cost.

Charting the Relationships Developed

When graphically illustrated, the production per hour increases in direct proportion to the number of doffers used until the perfect cycle is reached. The curve then bears directly on the small saving in setup time. This is illustrated in Exhibit 1. The costing rate per machine hour (burden and labor at standard) would obviously increase in a straight line as additional doffers are added, as in Exhibit 2. The manufacturing cost per pound would be a resultant curve of production and cost per hour. This shows in Exhibit 3.

Application of these general relationships may be made in any type of industry where setup change or fill-in time is required at regularly scheduled intervals. Too often the cost department considers such a study outside its scope. While it would seem primarily the function of an industrial engineering department to determine the most efficient methods of operation, there are cases in which an analysis of the unit cost at various levels by the cost department may derive results contrary to the findings of other departments that are concerned only with prime costs and maximum production per machine. Any study that has a bearing on unit costs involving fixed and variable charges should come within the scope of the cost department.

Computing the Premium Cost of Small Orders

In our business, which is classified as a service industry, the small order is becoming an ever-increasing problem. It has been our opinion that the rate of profit on an order should not be determined by the number of hours required to complete it, as is frequently the practice—the premium or higher profit rate being charged below a certain time limit—but rather that orders should be minimum-priced in accordance with a more accurate indication of cost facts.

With this thought in mind, we have devised an order cost chart illustrated below. Our first problem was to determine what we considered a standard size order and to relate running time to elapsed time, this ratio to represent the normal for orders on which no special charge be made. We classified all orders for a number of years, adhering for this purpose to the number of hours required to complete them. From this classification we were able to determine which orders were most frequent. This then established our standard order. In the data given, it is shown as fifty hours.

As will be seen, the order cost chart relates the elapsed time to estimated running time for all orders over a comprehensive time range and also relates this ratio in each instance to the same ratio for our standard jobs. The tabulation assumes that the idle time amounts to four hours per job. If the running time of the standard order is 50 hours, elapsed time will be 54 hours or 1.08 times running time. The chart, with hypothetical figures shown, is arranged as follows:

Estimated running time in machine hours	*Elapsed time in hours* (First column plus 4)	*Number of times elapsed time exceeds running time* (Second column divided by first column)	*Factor representing difference of third column ratios from same ratio for standard job* (Third column, less 1.08, divided by 1.08)
1	5	5.0000	3.6296
5	9	1.8000	.6666
10	14	1.4000	.2962
15	19	1.2666	.1722
25	29	1.1600	.0740
50	54	1.0800	.0000
100	104	1.0400	(.0370)*
150	154	1.0266	(.0494)*

* Quantities in ( ) are negative.

To use the table the estimator need only refer to the first and fourth columns. He determines the estimated running time required to process the order completely and the cost for this time for the standard order. This conversion cost is then multiplied by the appropriate factor from the table. The resulting amount, representing the premium cost due to length of run, is added to the conversion cost before a price is quoted. As an example, an order of 25 hours running time with a conversion cost of $50 would be computed to cost $50 plus the product of $50 and .0740, for a total manufacturing cost of $53.70.

Contributed by GEORGE D. LAWRENCE, *South Bend Chapter*

Cost Index Method for Determining Insurable Values

The most perplexing problem in placing adequate insurance for fire and related coverages is the determination of replacement and/or sound values on buildings and equipment, there being no particular problem in value of merchandise for these purposes, since goods are generally considered to be insurable at the price paid, if bought, or the cost to produce, if made. There are two reasonably safe ways to establish replacement and sound values for buildings and equipment: (1) by an appraisal by reputable appraisal engineers, which is the safest way but requires time and entails considerable expense, and (2) by use of published cost indices which require little time and only the ability to correctly make ordinary mathematical computations. These indices are usually available from insurance companies.

Sound value is current replacement cost less depreciation in accordance with age of the property. It is this value on which claim for losses is settled by all insurance companies, unless otherwise specified in the policy or by endorsement. Replacement value is full current replacement cost without any consideration as to age of property or depreciation. Insurance may be carried on this basis by application to insurers. By using published cost indices, the replacement value and/or sound value for adequate insurance coverage may be determined as illustrated below for buildings.

Our data is as follows:

Year	*Cost of building and additions* (Dec. 31)	*Building cost index** (Jan. 1)	*Current cost factor (1948)***	*Average age factor (to 1948)*	
1940	$150,000	102.2	1.89	(8 yrs)	$1,200,000
1941		109.2	1.77		
1942	50,000	117.7	1.64	(6 yrs)	300,000
1943	25,000	122.1	1.58	(5 yrs)	125,000
1944		126.6	1.53		
1945	25,000	133.6	1.45	(3 yrs)	75,000
1946		155.4	1.24		
1947		178.2	1.08		
1948		193.2	1.00		
Totals	$250,000				$1,700,000

* Hypothetical—start of year. **1948 divided by respective earlier indices.

A solution is now possible:

Year	*Original cost*	*Current cost factor*	*Current replacement cost*	
1940	$150,000	1.77	$265,500	
1942	50,000	1.58	79,000	
1943	25,000	1.53	38,250	
1945	25,000	1.24	31,000	
		Replacement cost		$413,750
Depreciation:				
Average age = 1,700,000 ÷ 250,000 = 7 years				
7 years at 1% = 7% of 413,750 =				28,962.50
		Sound value		$384,787.50

The same procedure may be followed for other classes of depreciable properties by using applicable class indices and depreciation rates.

Contributed by J. L. DAVIS, *Columbus Chapter*

A FORMS CONTROL PROGRAM

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It is made apparent in this article that a central point for ordering forms, maintained on a free requisition basis, is not a point of control and that the latter is an economy essential in present-day business operations. Nine aspects of lack of coordination which can develop in the absence of forms control are given and are matched by a nine-point program to effect such control.

THE ever-increasing number of reports necessary to operate a business today requires that mare attention must be given to the forms on which these reports are made. This is particularly true where a business has expanded into many departments, many buildings, or many locations. This article will describe briefly a forms control program which will assist in slowing up the increase of indirect costs. The program is not a cure-all which can be applied to all phases of indirect costs. Neither is it a one-time treatment. Instead, it is a control function applied to stationery forms and must be continuously maintained in order to yield the most benefit.

What Happens Without Forms Control

Let us consider for a moment a business without a forms control program. We will assume that there is a central point or a stationery stores department, through which all printing orders are cleared. The stationery department originates the purchase orders for forms whenever the inventory gets to a minimum position. Anyone wishing to change an existing form or to procure a new one brings a sketch to the stationery department where a purchase request is originated. No attempt is made to determine how the form will be used, how long it will be filed, or how much should be ordered at one time. The stationery stores personnel do not have the necessary time nor are they trained to write printing specifications.

Now let us see what has happened after a few years:

1. Without a forms control program the business has become flooded with many forms. No attempt has been made to

FORM PRINTING SPECIFICATIONS

FORM NO.	FORM TITLE	ESTIMATED NO. CONSUMPTION	ORDERING QUANTITY	DATE

KIND OF FORM: SINGLE SHEETS NOT PADDED	SINGLE SHEETS PADDED	SNAP-OUT	CONT.	CARD - NON TAB	CARD - Hollerith	OTHER - DESCRIBE	NO. SHEETS PER PAD	NO. SHEETS PER SET	NO. SETS PER PAD

NO. OF PARTS	TITLE OF EACH PART	PAPER SPECIFICATIONS WEIGHT, KIND, QUALITY, ETC.	COLOR OF PAPER	DIMENSIONS WIDTH	DIMENSIONS LENGTH	DEPT. NO. OF USING DEPT.	FILING SEQUENCE NUMERIC	FILING SEQUENCE ALPHABETIC	METHOD OF FILING LETTER FILE - POST OR RING BINDER, ETC.
1									
2									
3									
4									
5									
6									

IS THIS FORM USED AS A SOURCE DOCUMENT FOR KEY PUNCHING?	YES	NO	IF "YES" WHAT ARE NOS. OF CARD FORMS USED?	IF USED IN CONJUNCTION WITH OTHER MACHINES EXPLAIN:

FOR Hollerith CARDS ONLY: COLOR OF STRIPE AND LOCATION	CORNER CUT	BACK PRINTING ELECTRO NO.	IF BACK PRINTED INDICATE STYLE DESIRED →	HEAD TO FOOT — TUMBLE STYLE	HEAD TO HEAD — BOOK STYLE	IF THIS CARD IS PRODUCED WITH OTHER COLORS, STRIPES, CORNER CUTS, ETC. PLEASE DETAIL UNDER "REMARKS"
IF KEY PUNCHED, SHOW FORM NO. OF SOURCE DOCUMENT		OTHER SPECIFICATIONS - PREPUNCHING, PERFORATING, PADDING, ETC.				

METHOD OF PREPARATION: NO. OF COPIES MADE IN ONE WRITING	PENCIL	INK	TYPEWRITER	IF Hollerith ACCTG. MACH. SPECIFY TYPE	OTHER DESCRIBE

BRIEF DESCRIPTION OF USE OR PURPOSE:

ADDITIONAL SPECIFICATIONS - PUNCHING, BINDING, WRAPPING, METHOD OF PRINTING, SPECIAL INSTRUCTIONS, STAPLING, NUMBERING, ETC.

REMARKS:

USED BY: PLANT 1	PLANT 2	PLANT 3	PLANT 4		HD. OFFICES		OTHER - DIVISION	SUBMITTED BY - SIGNATURE AND DEPT. NO	REVIEWED BY - SIGNATURE AND DEPT. NO.

REPLACED BY FORM NO.	REPLACES FORM NO.

EXHIBIT 3

coordinate the various forms with the functions which they perform.

2. There is a great deal of duplication of effort. Many forms are used to record data which already is available on other forms. Not only is the printing cost wasted but, more important, the preparation labor cost is duplicated.

3. Without printing specifications, there is no control over the weight and grade of paper. Usually a sample of the form is sent to the printer who matches it the best he can. Sometimes it is necessary to substitute a better grade of paper, which means that the higher quality paper becomes the next ordering sample. A form that is filed for only a month and which should be printed on 16# sulphite may end up in a few years being printed on an expensive ledger paper.

4. Instead of a few standard form sizes which will fit common three-ring binders, there are a large variety of sizes. These odd sizes are not only expensive to print but there never seems to be a good place to file them. They will not fit into standard binders or files, with the result that special equipment must be used to stock and file them.

5. A survey of all the forms will reveal that there is no standardization of design. Many forms do not have headings, while others have no location for the date.

6. Sometimes an authorization to change a form is made by a person who does not know the entire procedure. As a result, the changed form will not work and is scrapped. The stationery scrap barrel may become a place into which hundreds of dollars are needlessly poured.

7. There is no record available to tell who authorized a form or who changed it. Some forms have been revised five or six times but no one can find out the reason for so many changes. Also, ideas and suggestions on improving a form are discussed from time to time but this data is not available when the form is reordered.

8. No one questions the originator as to how the form will be used. Many times it is not absolutely essential. Perhaps the data can be recorded just as easily on a columnar pad, or a careful investigation may reveal that the report is not necessary.

9. No attempt is made to establish a practical ordering quantity. An amount representing the originator's first guess is ordered. Usually this is too high, with the result that several years' supply is carried in inventory or the form becomes obsolete and the surplus stock is scrapped.

Essentials of the Control Program

The first step in establishing forms control is the selection of the control point. This may be an employee or a department. It may be a part-time or a full-time function, depending on the size of the business and the volume of turnover on forms. The personnel selected for this control function should be:

1. Familiar with clerical operations and procedures.
2. Intensely interested in reducing indirect costs.
3. Inquisitive.
4. Interested in standardization.
5. Possessed of some experience in forms design and layout.

The second step is to issue instructions to all departments so that every form will clear the control point. No matter whether the form is a new one or whether changes are to be made to an existing form, all requests must be reviewed by someone assigned to the forms control program. The department handling stationery stores must not order any forms until a Form Printing Specification (Exhibit 1), or its equivalent, has been prepared.

This specification sheet is prepared at the forms control point only, after a careful review has shown that the form is needed or should be changed. During the investigation the six basic questions of "what?" "why?" "where?" "when?" "who?" and "how?" are applied. Upon completion, the specification sheet clearly records the information needed by Stationery Stores and Purchasing for the procurement of a form with the correct grade of paper and in economical quantities.

Two copies of the Form Printing Specification are typed in each case. One copy of the specification is used by the stationery department to prepare an accurate purchase requisition. This copy is filed so that the stores department will always have the correct specifications available when a form is reordered. The second copy is retained by the forms control group where folders are filed in form number order. Into each folder is filed the specifications (of which several copies are made, one going to the purchasing department in connection with obtaining bids), the original layout of the form, a sample of the printed form, and all correspondence and suggestions. When the form is revised the new specification sheet and the new sketch are also filed. In this way an historical record of the form is gradually established.

What Is Achieved by Forms Control

Considerable more could be written concerning the indirect costs which are associated with the functions of a stationery store. However, we will not digress from our theme which concerns the cost of printed forms. Let us look at the nine conditions which we found in our earlier review of the forms situation and see what the forms control program will accomplish:

1. The lack of coordination will disappear. Instead of *everyone* telling the stationery department what to order, all form requests will be cleared through a control point and a form printing specification will be prepared for each approved request.
2. The duplication of forms will be eliminated. Every request for a new form will be carefully checked to be sure that no other form is being used for the same function. Not only will the duplicate forms be eliminated but also a saving in clerical time will be effected.
3. Every purchase order will carry complete specifications concerning the weight and grade of paper. If a substitute grade is necessary, the next order for reprint will go back to the standard specification. Often when a better grade has to be substituted, the printer will not charge extra since he wishes his price to be in line with competitors.
4. The majority of forms will fall into standard sizes so that the expense of special folders and files will have been reduced. Standard binders are much cheaper and will not be carried in stock. Furthermore, considerable saving will have been made in printing costs because the standard size forms will have eliminated the cutting waste which is always associated with odd sizes.
5. All forms will now follow a standard trend in design. The style of printing will be more uniform. Every form will have a title and will show the company name or insignia. A glance at any form will show that the accepted standards of good form design have been used. Good form design will increase clerical efficiency, while bad design will add to indirect costs.
6. No changes will be made to a form until a careful study has been made to determine the effect of the change on everyone concerned. A change will not be authorized until an agreement has been reached that the revision is necessary. Forms will not be scrapped as a result of making changes in a hurry.
7. An up-to-date record will be available to answer questions concerning forms. It will be possible to determine why

changes have been made in the past. The form printing specification in each folder will show who approved the form from the time it was started down to the latest revision. Also, this record will show suggestions and ideas that are to be incorporated with the next change. The form specification record will answer many of the questions which formerly went unanswered because someone's memory had slipped or the person who had worked on the form had been transferred.

8. Every request for a new form will be investigated to determine the need. Many times clerks will attempt to have a form printed because they wish to "dress up" a report. In other cases, it will be discovered that figures and statistics are being compiled which are not needed or are not being used. Careful attention will be given the labor element behind every form because the labor cost for preparing and handling the form is much greater than the printing cost.
9. Each form printing specification will set up an "ordering quantity." This is determined as nearly as possible by considering the following factors:
   (a) Monthly usage.
   (b) Number of months of stock to be carried.
   (c) Delivery schedule.
   (d) Economical purchasing quantities.

   Establishing practical ordering quantities will reduce the inventory carrying charges on stationery stores and will make available more room in the stock area. If a form becomes obsolete, only a minimum quantity will be destroyed. Also, when revisions become necessary the stock on hand can be used up in a short time without holding up the use of the revised form.

For Efficiency and Economy

A forms control program will help to eliminate the waste that is usually found whenever the ordering of forms is left as a function of the operating departments. Good form design, standardization of sizes, prevention of duplication, careful checking of changes, and the determination of practical ordering quantities can only be achieved by routing all forms through a control point.

The savings that will be realized will more than pay for the cost of the program. However, once a forms control program has been established it must be continually maintained or else the forms will drop back into the chaotic conditions in which they were originally found.

PRACTICAL EXPENSE ANALYSIS TO SERVE THE NEEDS OF HOSPITAL MANAGEMENT

by MURPHY COLE,
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Noting the position of the hospital in a community and the need for information on which to set or explain charges, as well as operating needs for cost data, the author of this paper presents a compact expense allocation sheet which has proven serviceable in practice. Included in the presentation is comment attesting to the significance of accounting to a hospital administrator.

IT has truthfully been said that a hospital administrator is a person who knows a little about all functions of the hospital. He must know at least a little about engineering, laundry, pharmacy, x-ray, surgery, nursing, housekeeping, teaching, accounting, and social service. Most important of all, he must be able to select the proper personnel to head the various services and departments and to coordinate the efforts of all those who work with him. In addition, he must interpret the function of his hospital to the people of the community, and make clear its role in the field of curative and preventive medicine.

Accounting As a Partner of Administration

The administrator may often be called upon to state the reasons for charges and rate structures as a basis for charges against the patient and perhaps even to defend the rate structure of his hospital. Without a knowledge of accounting, he would be in a poor position to be able to interpret rate structures or charges to patients, either to the patient or to the public at large. In fact, a comprehensive knowledge of the principles of accounting, and the ability to use and interpret the results of cost accounting techniques is a desirable qualification for anyone engaged in the field of hospital administration. The more the administrator knows about accounting the better he will be able to coordinate personnel assignments, equipment needs, and other departmental needs with the main function of the hospital, viz., to render the best possible service to the people of his community and in the most economical and satisfactory manner.

Services and Service Costs—In the Large

In every sense of the word, a hospital is a service institution. It has nothing to sell but service and the service it renders is rendered, almost entirely, directly by people. It has been said that a hospital *is* people. The people who serve in hospitals range from the hard-working pot washer or janitor clear through the scale of technically trained individuals such as technicians, nurses, supervisors, department heads, bookkeepers, social service workers, etc., to the administrator or superintendent and the medical staff. Fortunately or unfortunately, all hospitals cannot concern themselves solely with the scientific end of care and treatment of the sick. Some would like to do research work. Some would like to provide the community with out-patient clinics or to help in whatever preventive medicine programs are being pursued in the community. They would like to teach nurses, doctors, social service workers, and laboratory and x-ray technicians. The vast majority of all hospitals, however, must confine their efforts to one function, namely, the reception and care of the sick and injured, including the provision of therapeutic and diagnostic facilities, operating and delivery rooms, and such service departments as the hospital must necessarily have to perform this one function. These service departments include dietary, laundry, heating plant, and maintenance.

The service departments constitute the greatest cost of hospital operation. If nursing services—including diagnostic and therapeutic x-ray, drugs, operating rooms, laboratories—were all that were required to render the one vital service of a hospital we would find that the total cost to the patient could be reduced by approximately fifty per cent of the present cost. In other words, we find that feeding the patient, laundering his linens, cleaning his house, and keeping him warm, that is, the hotel functions, amount to some fifty per cent of the entire cost of operation.

Light Shed by Unit Costs and Comparisons

Statistical information, a specialty of accounting, plays a large part in hospital accounting. Average patient stay, average number of patients, the number of procedures performed by a laboratory technician, the distribution of nurses per patient, and nursing time spent with each patient are illustrations of information needed to judge the efficiency of a department, and in turn, of a hospital.

To illustrate: the determination of the cost of laundry on a piece (or pound) basis enables the administrator to know (and not to wonder) whether a laundry should be operated by the hospital or whether commercial laundry service would be more economical to the hospital. In the dietary department, the raw food cost per meal must be calculated and the administrator must know enough about such costs to be able to judge whether the department is following an effective system of food purchasing, preparation, service, and conservation.

To compare his own hospital with other hospitals in general, and more specifically, with other hospitals in his own state which operate on a comparable basis and have approximately the same number of beds, is a relatively easy matter when the administrator knows something of accounting. The cost per patient day, the percentage of occupancy, and the adjusted cost per patient per day are his means of comparison. So the administrator, while he may have people who can interpret such data for him, is in a better position to make his own interpretations and comparisons if he has an accounting background.

The Question of Rates

The rate structure of a hospital, though it does not change often, must be constantly studied so that the patient will not be exploited and so that the hospital will receive reimbursement on a fair basis for the services rendered or material furnished. Rates should be in proportion to the cost of services rendered and, unless some measure of cost accounting is applied the rate will be, at best, merely an approximation of the cost. The intent is that patients in private rooms should not pay exorbitant rates for that privacy, patients in semiprivate rooms should pay a rate equal to average actual rates (or cost), and patients in ward rooms should pay a rate slightly less than actual average cost per day (this basis should not apply if the patient is deliberately seeking ward accommodations in order to enjoy the benefit of a rate less than cost —when we speak of wards we mean the free or part-free wards where the indigent patient is cared for).

Room rates account for approximately fifty per cent of the earned operating income of a hospital. The remainder is realized approximately as follows:

Operating Expenses—Reallocated on a Departmental Basis

Ledger account	Basis of allocation	Ledger totals	Pharmacy	X-ray dep't	Laboratory	Operating rooms	Maternity dep't	Nursery	Out-patient and emergency departments	Physical therapy	Anesthesia	Room and care of patients
Dietary	Number of meals served	$ 6,650	$	$ 250	$ 375	$ 450	$ 300	$100	$100	$ 75	$ 50	$ 4,950
Laundry	Number of pounds	600		20	15	45	50	20	10	5		435
Housekeeping	Floor area	900		30	25	100	100	10	25	10	5	595
Plant operation	" "	600		40	20	75	50	5	10	5		395
Maintenance and repair	Time reports	400		20	20	30	20	5	10	10		285
Depreciation	Depreciation register	1,800		125	30	100	75	5	10	5	5	1,445
Medical and surgical supplies	Pharmacy requisitions	2,900	2,900									
Nursing service	Payroll	4,800										4,800
Nursing education	Duty assignment sheets	1,400				200	200	75	75			850
Nurses' residence	Number hours on duty	400				40	40	30	15			275
Medical library	Time basis	350				20	10	5	10			305
X-ray department	Total direct charges	800		800								
Laboratory	" " "	1,400			1,400							
Operating room	" " "	1,600				1,600						
Delivery room	" " "	1,500					1,500					
Physical therapy	" " "	200								200		
Nursery	" " "	500						500				
Anesthesia	" " "	500									500	
Pharmacy operation	Time basis	400	345	5	5	15	15	5	5		5	
	Subtotals	$27,700	$3,245	$1,300	$1,930	$2,975	$2,760	$810	$370	$310	$565	$13,435
	Per cent		11.7	4.7	6.9	10.7	9.9	2.9	1.3	1.2	2.1	48.6
Administration	Percentage basis	$ 2,300	$ 269	$ 108	$ 158	$ 246	$ 227	$ 66	$ 29	$ 27	$ 48	$ 1,391
	Totals	$30,000	$3,514	$1,408	$2,088	$3,221	$2,987	$876	$399	$337	$613	$14,826

Exhibit 1

Special services:	
Operating and delivery rooms and anesthesia	15%
Diagnostic services	13%
Treatment:	
Drugs, surgical dressings, therapy	14%
Miscellaneous professional services:	
Therapy, nursery care, oxygen	5%
	47%

When a hospital has no endowment income or governmental support for the indigent patient, rate structures for all patients will be necessarily somewhat higher than would be the case otherwise—and in direct proportion to the amount of charity work rendered by the hospital. Also, the rates must be sufficient to provide *actual* collections equal to cost of operation. In other words, let us suppose that the rate structure in a given hospital would produce earnings of $500,000 per year and that $25,000 of such earnings is uncollected because of bad debts, charity, or both. If the operating expense is also $500,000, then the hospital would have to adopt a basic rate structure that would produce earnings of $525,000 per year to realize sufficient amounts to meet operating expenses.

Something like this is precisely what virtually every hospital in the country is forced to do if it renders care to indigent patients without an adequate endowment income or support from subdivisions of government. Administration should be able to provide the governing board with financial statements and with financial data to clearly illustrate this situation in terms of dollars and cents. A financial statement presentation of the write-off for bad debts, charity, and discounts would deduct such write-offs from the earnings, viz:

Income:		
Gross earnings		$xxxxxxx
Less:		
Charity allowances	$xxxxxx	
Discount, etc.	$xxxxxx	$ xxxx
Total earnings (realizable basis)		$xxxxxxx

Useful Allocation of Costs to Departments

Keeping in mind the problems which have been touched on so far, let us concentrate our attention for a while on a simple yet

practical method of reallocation of costs of operation as reflected by the trial balance. The statement has as its purpose the allocation of all expense items in the trial balance directly to the using departments but more particularly to the earning departments. In this work-sheet presentation, we are not even interested in the cost per unit within departments. Given the costs and statistical information necessary, all the costs within any department can be broken down into as minute detail as is wanted. Here we merely wish to show a practical and easily obtained reallocation of costs, as reflected in the books of account, over to a departmental basis. The purpose of the work sheet is to furnish financial data more nearly accurate with regard to costs of various departments than the primary accounting records will show. The end result of the work sheet is to provide financial information for basic studies of costs of various departments of the hospital.

The illustration afforded by Exhibit 1 has been worked out on the basis of a cost of operation equal to $1,000 per day. However, the figures are fairly proportionate and representative. If a given hospital has an average over-all operating cost of $2,000 or $5,000 per day, it would be found that two or five times the figures given in the illustration would be fairly representative. Nor is the work sheet designed to reflect accurate average figures but more to illustrate a method of reallocation. It is, of course, apparent that the column headings could be further broken down, e.g., room and care could be set out separately by type of accommodations.

The work sheet is designed to be used as the means of obtaining total costs per patient day for the whole hospital and by departments. It is also of primary inmportance to:

1. *Determine whether the rate system of the income producing department is adequate*—For example: To determine whether daily rates are adequate and fair, we obtain the total allocated cost of furnishing room and care and divide the total by total number of days of hospital care furnished during the period under study. This gives an average cost per day. The earnings record reflects the average income per day for room and board. If the average result is unsatisfactory, then both cost and earnings could be further broken down to the average income as compared with costs in ward beds, in semiprivate rooms, and in private rooms. If a day rate change is under consideration, a number of other intangibles would naturally be taken into consideration. In some cases it is necessary to set a daily rate which is less than cost, and to make

up the difference in other income producing departments. Factors that may affect the decision could be: prevailing rates in other hospitals in the community, the class of patient being served, and the type of illnesses being cared for in the accommodations.

2. *Implementing of public relations*—For example: We know that the total hospital bill is high. We have an obligation to explain to the public in an intelligent manner why we must charge, say $7, $8, $10, or even $12 per day for a private room. But first we must know why the cost is that high and we must know what is actually involved in furnishing that room and board.

3. *Guide to operating policy*—For example: A given department may be producing an income in excess of the cost of operation in that department. This may be necessary in a particular hospital in order that operating losses in one department may be (justifiably) offset in another department. Ordinarily the pharmacy and x-ray departments do produce income in excess of the expense of operation of those departments. Significantly in this case, the administrator should known what and why earnings in this or that department are helping to offset the losses in another department. He may even be called upon to justify the fact. Seldom does an out-patient department earn more than a small percentage of the cost of operation and, while the administrator may have little difficulty in proving the justification for the department, he may be hard pressed to suggest ways to meet the expense of operation. It may be necessary for the governing board to determine policy and leave to the administrator to determine how to meet costs.

Looking again at the work sheet, it can be seen that the percentages shown near the bottom furnish a very handy way of comparing the efficiency of operation of one hospital with another. While actual cost of maintaining a laundry or dietary department may mean little or nothing in comparing two hospitals, the percentage of cost of those departments to total cost is of considerable significance and the wise administrator is ever on the alert to see how and where he can possibly reduce the cost of operation and still maintain essential care to patients on a high level.

Any number of other conclusions can be reached simply by using the basic illustration offered by the work sheet. X-ray provides an instance. Its ledger cost is shown to be the direct cost of salaries, supplies, and fees. By allocating all other costs on a fair

basis, we have quite a different cost figure. Suppose we wished to determine whether charges to the patient in this department were justifiable. It is a simple matter to determine the cost per unit—which would be the number of films taken—divided into the total cost. And, if we wished to be specific, we could easily determine whether the $5 charge for an x-ray made yesterday of a foot was actually justified.

Relationships with Medical Staff and Others

Administration must always be ready to justify rates and policies to a sympathetic though questioning doctor. It is no reflection on the doctor if he does not know the problem the hospital may have in meeting its financial obligations. On the other hand, it would be a reflection on the administrator if he did not know why a certain rate existed or whether the hospital could afford, financially, to do a particular thing or to perform a function which the doctor sincerely believed to be essential.

Much of the work in a hospital is actually performed by doctors with whom the patient may not come in contact. Radiologists are doctors. The same is true of pathologists and anesthesiologists. Almost all hospitals have a contract or agreement with the doctor with regard to the method of reimbursement for services performed in the fields of radiology, pathology, and anesthesiology. While the charges for these specialized services may appear as a part of the patient's bill, the patient is not always able to understand why his bill should be so high. But payments to these specialists, whether fees, commissions, or salaries, must be passed on to the patient and in proportion to the services he has received.

Department heads may wish to acquire additional equipment, facilities, and personnel. Administration must know whether the hospital can justify such outlay financially and must be able to determine whether it will result in better service to the patient.

Trustees are usually business people, or, more specifically, laymen who give of their time to the hospital freely. They are often busy and usually represent the finest people in the community. They will naturally wish to be informed about the financial condition of the hospital. Administration must be able to talk the language of business executives. Trustees are charged with policy-making functions, but they must depend on administration to help guide them in making decisions.

THE COST FORUM

Investment Basis for Distribution of Administrative Expenses

Editor, N. A. C. A. Bulletin:

"Net Profit Analyses for Profit Betterment" by W. A. Hensel, presented in the September 1949 issue of the ***Bulletin,*** discusses the importance of properly analyzing selling and administrative expenses so that management may have accurate "net profit" guides. While Mr. Hensel has very specific recommendations for the distribution of selling, distribution, advertising, and promotion expenses, he states that "administrative and general expenses must be allocated on an arbitrary basis either on sales dollars, cost dollars, or gross profit dollars." He advises allocation on the gross profit dollars "on the theory that those products or branches which contribute the largest gross profit indicate the greatest administrative effort and, therefore, should bear the greatest share of administrative and general expenses."

Mr. Hensel's recommendation is subject to question, first, because weak or "sick" products place just as heavy a demand on management—and perhaps a heavier one—as those which are earning a healthy gross margin, and, second, because such distribution reflects "ability to pay" rather than the actual use of top management's talents and efforts. Management's first responsibility is the stewardship of the stockholder's investment and the employment of these funds in such manner as to return a reasonable profit. For this reason the general administrative expenses, which normally include the president's, secretary's, and treasurer's offices, and other general services which cannot be assigned to products on the basis of specific demands, may well be allocated on the basis of the relative investment required by each commodity line. Such basis is logical both for current as well as long-range reporting.

The exhibit below compares the gross profit dollar and the investment bases for distribution of administrative and general expenses. It is evident from the figures, which distribute an aggregate administrative expense of $150,000, that the investment basis tends to correct results obtained by use of the gross profit basis:

	Product A	*Product B*	*Product C*
Net sales	$6,500,000	$5,000,000	$4,500,000
Per cent gross profit on sales	25%	30%	3%
Gross profit dollars	1,625,000	1,500,000	135,000
Per cent of total gross profit contributed by the product	50%	46%	4%
Investment	5,000,000	6,000,000	5,000,000
Per cent of total investment devoted to the product	31%	38%	31%
Distribution of administrative expense			
1. On gross profit dollars	75,000	69,000	6,000
Per cent of sales	1.2%	1.4%	.1%
2. On investment	46,500	57,000	46,500
Per cent of sales	.7%	1.2%	1.0%

In this hypothetical example, profit guides are distorted in varying amounts up to nearly one per cent on sales if management's expenses are assigned to products on the basis of gross margin dollars. Such distortion could be even more significant in the experience of specific companies, particularly where there are relatively heavy investments in products returning low gross profit dollars.

FRED J. MUTH, *Lancaster Chapter*

Effective Review of Slow-Moving Items in Inventory

Editor, N. A. C. A. Bulletin:

Now is a good time to get a slant on possible inventory write-off at the end of the year for slow-moving items. So far, this has been a difficult year for determining slow-moving items because business in many stable lines has not been up to normal for the first six months. However, late summer and early fall business has shown improvement which, in many lines, is an indication of where to expect activity in the future.

It may be impossible at this time to determine how much write-off will be required for slow-moving items at the end of the year, but at least a portion can be definitely determined after a review of finished goods inventory by the cost accountant. This list can be presented to sales and production officers for their opinions of what items will be slow-moving at the end of the year.

An easy approach to the problem can be taken by making a listing along the following lines:

Item	Balance Jan. 1	Production Jan. through Sept.	Sales Jan. through Sept.	Balance Oct. 1 (or later mo.)	Unit cost	Inventory amount

To make the job as easy as possible, units only (omitting value) will suffice for all columns before "unit cost." The last two columns, stated in money values, are pretty sure to serve to spotlight major items and to have a thought-provoking effect on individuals reviewing slow-moving inventories. When reviewing inventories seasonal items must be kept in mind.

The items to be presented as slow-moving will vary with the kind of business. Generally one can be guided by normal inventory turnover for the year. For example, if normal inventory turnover is four times per year and sales of an item have not exceeded the balance at January 1 for the period January through September, there is a reasonable indication that it is properly classified as slow-moving.

After slow-moving items in finished goods have been determined, it is well to review raw material and work in process inventories to determine whether or not they are affected by the same items. Such an advance determination of write-off, even if not complete, may ease a shock in the month of December.

ELMER H. BAKER, *St. Louis Chapter*

Basis of Reporting Depreciation for Industry Statistics

Editor, N. A. C. A. Bulletin:

One implication of depreciation based on replacement costs has been overlooked in most of the discussions of the past two years. This is its relationship to industry-wide statistical cost reporting. It seems to me that the replacement cost basis should be used to determine the depreciation charge reported to trade associations which sponsor uniform accounting systems and collect operating statistics based on these systems.

There are several hundred of these uniform systems in existence at the present time. The purpose of most of them is to serve as a means of calculating average industry-wide performance, so that the individual association member can compare his results with those of the industry as a whole. Generally, the summarized results are expressed as percentages of sales, the total of each of the various expenses reported by members being compared with their total sales. In the usual case, most of the expenses reported are of the type incurred currently. In respect of any of these, the association member can validly compare his expense percentage with the composite expense percentage shown in the trade association's summarization and get some idea of how his performance measures up against that of the whole industry.

Depreciation expense, however, does not represent a currently-incurred item. When an association gathers the total depreciation charge of members and divides this total by total sales of reporting companies, it arrives at a percentage which the individual businessman cannot use as a basis of comparison with his own depreciation charge. While the sales figures used by the trade association in this calculation are all transactions of a single year (the year for which the percentage is computed), the total depreciation expense is not the aggregate of write-off of assets acquired during a single year. Association members ordinarily use historical cost as the basis of depreciation fixed assets. The depreciation expense of each member is the amortization of the costs of the years of acquisition of those assets. For each member, the proportion of the costs of various years reflected in the reported amount of depreciation differs. The various members, therefore, report charge-offs of costs of fixed assets bought at a number of different price levels.

The depreciation charges are summarized by the trade association as identical dollar write-offs, are divided by sales in current dollars, and result in a depreciation expense percentage to sales representing the average percentage for the reporting members of the association. In this process the write-offs of outlays made in past years for plant and equipment are lumped together as if they were all the write-offs of the costs of a single year. There is nothing to differentiate between ratio to sales of depreciation taken by established firms and by those whose plants were more recently acquired.

To make the depreciation charges of the various members comparable so that measures of individual against association performance may be of value, the uniform accounting systems of the various trade groups should provide for replacement-cost depreciation. In this way, the total depreciation charge

of members will represent write-offs based on costs of a single year, the current year. To make this possible, each association might prepare a yearly price index or indexes of fixed asset costs for its industry. Members could adjust their depreciation charges based on historical cost in accordance with the index.

LEON M. NAD, *Philadelphia Chapter*

Reducing Trucking Costs

Editor, N. A. C. A. Bulletin:

Early in 1948 the need for additional trucking capacity developed at our plant. We were using three cab-over-engine trucks with flat bodies, size seven feet by sixteen feet, and it was necessary for us to have four truck drivers and two helpers. These men, in addition to driving trucks, assisted in the loading and unloading of them. Before purchasing additional equipment, we decided to analyze this operation and had our standards department make a study of it. This study revealed that much of the drivers' and helpers' time was spent in waiting for the truck to be loaded and unloaded.

It is necessary for us to truck finished goods to the warehouse, our warehouse being located apart from the main plant, and to bring a portion of the material back to our stockroom as it is needed to fill orders. Supplies such as cotton, cases, etc., are also stored in this warehouse and have to be trucked to our main plant as needed. In addition to these operations, we haul our outbound and inbound shipments to and from the various railroad stations and truck line terminals.

After a thorough investigation, it was decided to use semitrailers with bodies eight feet by twenty-four feet. By using these trailers, we could park them at our loading platforms, and, as the goods came through, they could be loaded by our regular platform trucking crews. We figured that three trailers could be handled in this manner by one motor unit, thereby reducing the number of drivers and helpers needed. We also made arrangements with the various transportation companies to leave loaded trailers at their platforms for unloading, switching them when unloaded much in the manner of box cars.

It appears that we will realize a saving in direct labor equal to original cost of the new equipment in approximately two years. In addition, the new method gives us the following advantages, further reducing our costs:

1. Better utilization of warehouse crews.
2. Less fuel and maintenance costs.
3. Larger loads and longer life of equipment.

The new equipment was delivered in June 1948 and, after checking its operation for a period of six months, it was decided to purchase an additional trailer and motor unit. Two of our original trucks have been disposed of and the third is used occasionally for small shipments and odd jobs.

G. LOUIS GOODMAN, *Chattahoochee Valley Chapter*

Centralized Timekeeping

Editor, N. A. C. A. Bulletin:

We have two hundred machine operators and because of the layout of the plant and type of work have had four timekeepers. They were seldom very busy and I had always felt that we could reduce our personnel if there were some way of centralizing the work. We finally decided upon a communication system, with the centralized timekeeping department located in an office near the standards and production control departments.

No operator has to walk more than fifty feet to make a call. The call box stands about five feet from the floor and the operator, by touching the top of the box, flashes a light in the central timekeeping office. The lights are coded to each department in the factory so that the girl operating the master stations knows which department is calling in and can have her hand on that particular department's time card before she answers. When going on a job the operator gives the job number, part number, operation number, and machine number. When going off a job the operator needs only to give the number of pieces finished. The employees' time card is laid out with information spaces in the foregoing sequence so that the girl can very quickly put down the information.

After two weeks' operation, when the machine operators have become used to calling in, a call can be completed every eight seconds. Monday morning is our busiest time because it is necessary for all employees to call in. The foremen stagger their departments for this purpose at three-minute intervals. The result is that one girl at the central station, with another to help her during rush periods, can do the job very satisfactorily. In our case the second girl, when not needed to record calls, is employed in posting the standard setup and running time on the employees' time cards in connection with our standard cost work.

It may be mentioned that the equipment used provides for two-way communication. The girl at the central office can talk back to the operator reporting and have him repeat information which she may have misunderstood. A foot pedal arrangement, which leaves both her hands free to operate the files and write the information, permits this.

We keep a file of job orders which shows, among other things, the standard time allowed on each operation and the quantity called for on the order. Hence, an employee cannot turn in more pieces than the order calls for. We also have the foremen check their operators by calling in to timekeeping to ask what job number their respective operators are checked out on.

We have found that the entire procedure works very satisfactorily and that the employees like it. We have not only reduced timekeeping staff needed but have also increased our efficiency, in so far as it takes less time than before for the machine operator to have his time recorded. The system also operates to make it easy to call any wide variations between the actual time and standard time to the attention of the standards department promptly. In addition, the production control department can find out very quickly what parts are being run over particular machines.

LOUIS S. CONGDON, *Indianapolis Chapter*

Detailed Reporting of Supplies Consumption

Editor, N.A.C.A. Bulletin:

In organizations whose supply costs are high, it is often desirable to have these costs accumulated by type of item by department, in order to keep them under control. We have found that this job can be done quickly and economically on tabulating equipment.

A master list is set up of all expense materials, with a code assigned to each type of item. For instance, the code for brooms is -01, gloves -02, oil -03, light bulbs -04, etc. When these items are withdrawn from the plant stock room, this code is written on the drawout. Department 1-02 would signify issuance of gloves for Department No. 1. If a unit price is used by the office stores department for pricing, this too can be computed in the tabulating department by means of the group master card multiplying procedure. Then, at the end of the month, the tabulating department forwards a summary to the stores record group. Incidentally, this procedure entails only one stock record posting for each type of withdrawal. The posting will show total quantity and total cost by item and department.

Each foreman or department head is furnished promptly at the close of each month with a list showing quantity and cost, by items, of supplies which have been charged to his department during the month, so that he can readily see which items require attention from a usage viewpoint and can take corrective action. We believe that this is an excellent application for tabulating equipment already installed, because it is not a job which entails great volume. It can be used as a fill-in operation between the peak loads of other tabulating jobs, such as payroll, billing, and others.

D. M. WELLS, *Mohawk Valley Chapter*

Forms and Methods—And The Internal Auditor

Editor, N.A.C.A. Bulletin:

Earl A. Green's article "Internal Audit of Cost Functions—Procedures for Auditing Standard Costs" (August 1, 1949, issue of the *Bulletin*) presents an excellent review of the internal auditor's place in cost accounting. However, isn't his interpretation of auditing stepping into the fields of other functions? I have particular reference to the systems and methods department. When the auditor appraises and designs departmental forms and reports, he may be, to some extent, usurping the duties and responsibilities of a systems and methods unit. If he is to do a thorough job of evaluating the appropriateness of various forms, he leaves himself little time to devote to his major role, that is, to assure the reliability and completeness of operating data supplied to the management.

Most manufacturing concerns as large as Mr. Green's company do maintain an important branch specifically charged with the task of appraising, coordinating, simplifying, and unifying departmental forms and reports, so that each bit of information assembled fits properly into the complete company picture of operating results. Not only does the systems and methods

department answer this management need by designing new forms and improving existing ones, based on the unit's own studies and the recommendations of department heads (or the suggestions of auditors, too), but the department is also entrusted with the job of keeping down expenditures for printing or other reproduction of forms and reports. Some worthy suggestions for improving reports are discarded only because the cost outweighs the benefit.

Even in organizations which are not large enough to support a separate department for the innovation and review of systems and methods, management might well consider the advisability of assigning part-time duties of this nature to a qualified employee. Such employee should have a comprehensive knowledge of the workings of each department as well as a clear understanding of the facts management wants to know. Let's not lose sight of the fact that the job of systems and methods is a distinct departure from the normal scope of the auditor's job.

GARDNER RICHARDS, *Scranton Chapter.*

Circular "Out" Cards to Mark Withdrawals from Files

Editor, N.A.C.A. Bulletin:

In using vertical card files, it is frequently necessary to refer to data therein and to remove cards from the file. In some cases, when this is done one card is tipped up to mark the place so that, if others refer to the file before the card is returned, there will not be any confusion. This makes it awkward to close the drawer and damage may be done to the card. Also, one never knows certainly whether the card tipped is ahead of or following the card removed. There is a possibility of misfiling for this reason.

We have had blank round cards or discs cut a little larger than the vertical side of the file card. This disc card is inserted in the place from which a card has been removed. The drawer may then be closed without difficulty and any other reference may be made to the file. When the original card is to be returned to the file, it is very easy to locate the exact spot by the round card. The discs are very inexpensive and a supply is kept by the file, so that they are easily available. Because it is circular, there is no need to pay any attention to the way the disc is dropped into the file.

The discs should be about an inch larger than the cards. This will permit them to be above the cards and guides, no matter how they are dropped in, and still will not interfere with the operation of the drawer. Contrasting colors may be used so they will show up immediately as soon as the drawer is open. Their insertion also serves to signal that cards are out of the file and should be returned. If so desired, notation may be made on the disc by the person removing a card for ready checking for the return and to place responsibility for the missing card.

We have found the above procedure very effective. Perhaps it may be of value to others who are operating card files.

CHAS. A. KUNTZ, *Columbus Chapter.*

Effecting Cost Control Under Project Authorizations

Editor, N.A.C.A. Bulletin:

In our company all capital expenditures and expense jobs classified as changes or alterations (costing $250 or more) may be made only after they are approved through our Project Expenditure Authority procedure. This approval is issued at various management levels, depending on the amount of the project. Such a procedure resembles that in use by many companies. However, when there are a large number of projects of differing sorts, the problem of control is not always solved by the mere existence of a formal outlay authorization.

About a year ago we set up a system for controlling the costs of these projects to prevent expenditures in excess of the original approved amounts. Our first step was to set a list of standard job codes as follows:

Job code number	
	Buildings
1	Doors, hardware, millwork trim
2	Exterior painting or surface treating
3	Exterior walls
4	Foundations and footings
5	Floors
6	Heating and ventilating
7—25	Etc.
	Yard, roads, railways, etc.
26	Dam and headworks
27	Drainage
28	Fence
29	Landscaping
30—40	Etc.
	Process equipment
41	Air system and process ventilation
42	Heating equipment
43	Conveyors
44	Motors and starting equipment
45	Pumps
46—80	Etc.

All projects are originated by the engineering department on the basis of a detailed estimate of each job broken down by the standard job codes. The estimate is sent to the interested parties, including one accounting department, stores department, and the department doing the work. After the project has been properly approved and work begun, the labor and materials slips are coded with the project expenditure authority number, together with the proper job code.

For example, it may be assumed that work is being done on pumps in connection with project expenditure authority number 100 which is to be capitalized. All labor and materials chargeable to this job will be coded with the authorization number first, followed by the standard job code number. In this case, the correct coding would be 100-45. Any expense work chargeable to an expenditure authorization would be coded the same except that the job code number would be preceded by a cipher. 100-045 indicates expense work done on pumps chargeable to authorization number 100.

All charges to project expenditure authorizations are accumulated weekly in a job book with a separate sheet set up for each standard job code. By Wednesday of the following week a report is furnished to the engineering department for each job in progress, as follows:

Status of Project Expenditure Authority
By Job Classifications

For Week Ending ..... P.E.A. No.....

	Actual money spent						
	This week		To date		Orders placed not	Total spent and	
Job code	Material	Labor	Material	Labor	invoiced	obligated	Amount authorized
6	425.	750.	800.	1,430.	360.	2,590.	4,000.
9	50.	20.	140.	70.	1,200.	1,410.	1,500.
Totals	475.	770.	940.	1,500.	1,560.	4,000.	5,500.

This procedure has resulted in better estimates of project expenditure authority costs by our engineering department, more accurate accounting, and a very substantial decrease in the number of overruns.

S. H. WHEATER, *Mohawk Valley Chapter.*

Garage Stores Controls for a Manufacturing Company

Editor, N. A. C. A. Bulletin:

The following method of maintaining a control of and accounting for disbursement of garage stores for a company that possesses a large group of automotive and yard equipment used in plant operation and maintenance may be helpful to other companies with similarly extensive stores of the same type. Our garage storehouse is maintained as an auxiliary unit in connection with the automotive repair shop and plant service station. It serves as a point of distribution for gasoline, lubricants, tires, tubes, batteries, and minor automotive repair parts and supplies. An accounting separate and apart from the main storehouse is kept. However, only stores that can be distributed in measurable quantities, such as gasoline, various weights of motor oil, compressor oil, diesel fuel, automotive repair parts and supplies are carried in the garage stores account. Grease, rags, sanitary, and housekeeping supplies are charged to garage operations and not carried as stores.

Gasoline and automotive repair parts and supplies are taken into the garage stores account on delivery of material from a supplier. Lubricants are stored in the main storehouse in 55-gallon containers and, when needed to replenish stock, are withdrawn by the issuance of a storehouse charge slip requisition. (This tends to hold garage stores lubricant inventory to a minimum.) Two kinds of storehouse charge slips are used when materials and supplies are withdrawn, one for gasoline and lubricants, and one for automotive repair parts and supplies.

With respect to the first classification, electrically driven control meter type pumps are used in disbursing gasoline to vehicles and yard equipment. At the time either gasoline or lubricants are withdrawn from stock, a pre-

numbered gasoline and lubricant delivery ticket is filled out by the station attendant. This ticket contains space in which to list the plant equipment number, date of delivery, speedometer reading, cost code, and quantity of product withdrawn. Also, space is provided for the signature of the employee making delivery as well as the signature of the one receiving it.

At the beginning of each day's operations, the storeroom man gauges the gasoline storage tank and inventories the contents of the oil drums. This inventory is subject to verification without notice by the internal auditor at various times during the month. The previous day's delivery tickets are compiled and from this information a daily gasoline and lube oil report is made. The section of the report pertaining to the lubricants contains a column in which to list the various makes or brand names of motor, compressor, and diesel fuel oils on hand. Other columns are for: "on hand—last report," "receipts today," "total to account for," "amount delivered per tickets," "balance on hand per books," and "balance on hand per physical inventory."

A comparison is made of the gasoline deliveries as per actual meter reading and as per tank gauge. This is done by taking the difference between the opening and closing meter readings in comparison with the opening and closing tank gauge readings adjusted for the day's receipts. The tank gauge is the controlling factor, and an "over and short" column is maintained to list any discrepancies. Space is provided at the bottom of the report for a gasoline over and short summary. This is completed by bringing forward from the last report the amount that is either over or short and applying the daily difference, thus leaving an amount over or short to date for the current period. Unusual discrepancies are promptly investigated in order to determine their causes and to make necessary corrections.

Accuracy of these daily reports is confirmed by the works auditor. At the end of an accounting period, a recapitulation is made by a cost clerk of all delivery tickets by equipment number, listing the quantity of products used and applying the "first-in, first-out" unit cost. With this information, a voucher is prepared charging the various expense captions and crediting the garage stores account. An adjustment to the stores account for any amount shown as over and short is made at this time.

As has been indicated, a different garage stores requisition form is issued when automotive repair parts and supplies are withdrawn. A prenumbered charge slip with space for the signature of the person filling the order, date of issue, symbol number, quantity, article, unit price and amount, cost code, job order number, and the signature of the foreman, is used. The charge slips are prepared in duplicate. One copy is for the stores department. The original is sent to the cost clerk for pricing and entry on stores inventory cards. At the end of the accounting period, a garage stores distribution voucher is prepared crediting the garage stores account for withdrawals and charging the applicable expense accounts.

The garage stores vouchers are posted to an auxiliary automotive equipment ledger. Ledger totals are taken at the end of the accounting period, and from these an automotive equipment operating statement is prepared. This statement lists the vehicle plant equipment number, description of equipment, name of employee the equipment is assigned to, equipment license

number, miles traveled during the period, quantity and cost of gas and oil used, labor and material repair cost, new tires, tubes, and batteries cost, other miscellaneous expenses, average cost per mile, and average gasoline mileage obtained. This statement offers management a cost comparison as well as a check on garage stores consumed.

HARRY W. GEORGE, *Sabine Chapter.*

COMING ARTICLES

In the *N. A. C. A. Bulletin,* January 1950

A Study in Decentralization: Controllorship in a Divisional Organization
by E. B. Rickard

Standard Hours—A Common Denominator for Significant Reports to Management
by T. R. Elsman

At the Threshold of Events—The Services of Budgeting As a Management Guide
by K. C. Tiffany

Cost Control for Effective Control of Operations in the Manufacture of Aircraft
by F. O. Detweiler

Approaches to Some of the Accounting Problems in the Field of Atom Energy Development
by H. B. Eversole

Timely Issuance of Monthly Reports—An Outline of an Early Closing Procedure
by Richard H. Allen

Step-by-Step Analysis of Departmental Labor Variances
by Robert P. Dulude

Obtaining Costs by Shippers for a Contract Carrier of Motor Freight
by Robert G. Chenhall

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BULLETIN

IN THREE SECTIONS • SECTION THREE

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National Association of Cost Accountants
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FOREWORD

This report is the second in a series presenting conclusions drawn from a study of the variation of cost with volume. It describes techniques which may be used in business planning under conditions where it is desirable to treat volume and certain other factors as variable. Since these techniques have limitations which are sometimes overlooked, particular attention is given to the interpretation of conclusions reached by the use of such tools as the break-even chart and the marginal income analysis. Methods to aid cost control under conditions of varying volume will be covered in a later report of this series.

I. WAYNE KELLER, *Chairman,*
Committee on Research

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THE ANALYSIS OF COST-VOLUME-PROFIT RELATIONSHIPS

THE analysis of relationships between cost, volume, and profit can provide much information which is helpful to management in business planning. By such methods it is possible to study the effect that changes in volume are likely to have on profits. When these analyses are presented in the form of simple charts or summarized in a few key figures, management can quite readily visualize relationships that would otherwise seem complex and difficult to grasp. The same charts are employed by a number of companies for educational purposes in explaining to supervisory and technical personnel how costs and profits behave under conditions of varying volume.

This report points out the fact that the significance of cost-volume-profit analyses is largly determined by the reliability of the data from which they are prepared. The determination of how costs should vary with volume is basic to such studies. Moreover, unless management has effective control over costs, the analysis of relationships between costs, volume, and profits is apt to have comparatively little value because there is no assurance that projected results can be realized. The field study indicated that application of the techniques discussed in the report is most successful where the company has an effective budgetary program based upon good operating standards.

Proper interpretation of figures and charts derived from a cost-volume-profit analysis is essential. When a break-even chart is used, it is necessary to recognize the fact that it is based upon the assumption that factors other than volume remain constant. However, additional charts can be drawn to represent changes in such factors as selling prices, costs, and sales mix. Such a procedure may be especially useful for testing alternatives in planning. Where it is desired to study the effect that changes in volume of individual products will have on profits, the marginal balance approach may be especially useful because it does not require allocation of fixed costs which cannot readily be assigned to specific products.

Introduction

The profit and loss statement tells what the profit has been on the specific volume of business done during the period for which the statement has been prepared. This form of statement is appropriate when consideration is limited to a given volume, as it is when reporting historical results or when the statement represents the results anticipated at a forecasted volume. However, for the

purpose of planning and control of operations, volume is usually an unknown factor and must be treated as a variable. Under such conditions, costs and income are also variables whose amounts are to an important extent dependent upon volume.

By analysis of relationships between costs, volume, and profits it is possible to predict the probable effect on profits which may be expected to follow from a change in volume. The results of such analyses are usually presented in the form of break-even charts or in statements which show how the sales dollar is applied to cover variable costs, fixed costs, and profit.[1] An understanding of the relationships between costs, volume, and profits, together with factual information concerning the effects that changes in volume will have on the business, is helpful to management through a wide range of problems in planning and control.

This report describes techniques of cost-volume-profit analysis, discusses the interpretation of results, and illustrates applications which may be made of information from such analyses. It uses as a base the concepts and methods for measuring cost variation which were developed in the preceding report entitled "The Variation of Cost with Volume."[2] In addition, information concerning actual practice in the use of cost-volume-profit analyses was obtained from a field study covering fifty companies in various lines of industry.

Analysis of Cost-Volume-Profit Relationships

The analysis of cost-volume-profit relationships begins by determining how costs vary with volume. For this purpose the costs are classified as fixed or variable in order that the amount of fixed cost and the rate at which variable costs change with volume can be ascertained. Since profit is the difference between revenues and costs, the rate at which profit varies with volume is also determined. These three figures (i.e., amount of fixed cost and the rates at which costs and profit change with volume) are constant for any volume within range of the analysis so long as factors other than volume remain unchanged. Together they describe what may be

[1] While such other factors as prices, production facilities and methods, efficiency, etc., are assumed to be constant in any one analysis, the same approach may quite readily be extended to cover changes in these conditions.

[2] Research Series No. 16, *N. A. C. A. Bulletin*, June 15, 1940, Sec. III.

called the profit structure of the company. For presenting a given set of cost-volume-profit relationships, the break-even chart is commonly used and preparation of such a chart is usually an objective of the analysis. However, the analysis of cost-volume-profit relationships encompasses much more than can be shown on a single break-even chart.[3]

Reliability of Results

The reliability of these figures and charts depends upon the accuracy of the techniques of analysis employed and upon the inherent limitations of the data from which they are developed While previously published literature on cost-volume-profit analysis has been devoted largely to methods of analysis and presentation, these are, for the most part, relatively simple. In practice, provision of suitable data is often difficult and is an aspect of the subject which has generally received insufficient attention. However, most important of all is the proper interpretation and use of the figures and charts derived from such studies.

Sources of Data

Where flexible budgets and standard costs are available, these provide the cost data needed for the cost-volume-profit analysis. Selling prices and sales mixture are taken from the sales forecast. Forecasted quantities extended at standard cost rates are used to determine costs of direct material and direct labor. Manufacturing overhead, selling, and administrative cost budgets which have been broken down into fixed and variable components provide the necessary data for expense.[4] Amounts of the variable expenses at the forecasted volume level are obtained from these budgets. When

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[3] While extensive interest in the break-even chart seems to have developed rather recently, the fact that the chart has been known to accountants for at least 45 years is shown by the appearance of an illustration and explanation of methods for preparing such a chart in the *Encyclopedia of Accounting* edited by George Lisle and published in Edinburgh and London in 1904. The section referred to appears at page 217 and was written by John Mann, Jr., C.A.

[4] The field study disclosed a few companies having budgets which did not include a break-down of costs into fixed and variable components. Here the amounts of fixed and variable cost are estimated in order to compute a break-even point or to prepare a break-even chart. Such rough methods for determining how costs vary with volume necessarily produce results which are less reliable than those prepared from more accurate data.

these variable expenses are combined with direct material and direct labor, the rate at which total variable cost varies with volume is determined. Fixed components of manufacturing, selling, and administrative cost as determined in the respective budgets are added together to obtain a total. The essential figures representing the profit structure of the company as provided by the budget plan are thus obtained. If desired, these figures can be plotted in the form of a break-even chart.

Thirty-one of the fifty companies seen in the field study prepare a cost-volume-profit analysis regularly as part of the general process of preparing their budgets. Of these thirty-one companies, twenty-eight also prepare break-even charts to portray the cost-volume-profit relationships which underlie their budgets. Nineteen companies prepare cost-volume-profit analyses from time to time as special studies, but these companies do not consider the analyses to be a regular part of their budgeting procedure.

Companies without budgets rely upon historical records as the principal sources of data from which cost-volume-profit analyses are prepared. However, cost variations due to volume are here usually more or less obscured by changes in prices, products, methods and equipment used in manufacturing and selling, changes in accounting classification of costs, etc. Adjustments can be made to give the effect of holding constant certain of these nonvolume factors, but such procedures may be time consuming and the results are not always satisfactory.[5] Some companies lack historical data covering a sufficient range of volume fluctuation to allow establishment of the desired relationships. Where cost control has been weak, it may be impossible to find a significant relationship between costs and volume by studying historical records.

Financial statements are sometimes used or advocated as the source of data for cost-volume-profit studies in connection with analysis of investments or credit risks. While such studies may have value and interest, it needs to be remembered that they are based upon highly condensed figures which provide little or no indication of the effect which factors extraneous to the study have had in the fluctuations displayed by the charts. For this reason, the margin of error is apt to be very large.

[5] For discussion of methods see "The Variation of Costs With Volume," Research Series No. 16, *N. A. C. A. Bulletin*, June 15, 1949, pp. 1229-1235.

Variation in Revenue with Volume

Since the objective is to study the relationship between volume and profits, revenue must be expressed as a function of volume. In a manufacturing concern where revenue comes from selling the goods produced, revenue is usually best measured as sales value of production for purposes of the cost-volume-profit analysis.[6] Companies which receive their income from the sale of a service express revenue in an appropriate service unit. For example, an air transportation company uses revenue ton miles.

Where the budget is being analyzed, prices employed for converting production to sales revenues are those established by the budget. Ordinarily these prices represent the planned or expected selling prices of the company's products for the coming budget period. Analyses which use actual dollar sales figures from several preceding periods may be distorted by the effect of changes in product prices. Where this effect is serious, historical sales data can be adjusted with a suitable price index or physical quantities sold can be extended at the price prevailing at a given time.

Shifts in Sales Mix

Another problem which arises in studying the variation in revenue with volume comes from changes in sales mixture. As a consequence of such changes, the operating profit fluctuates with shifts in the mixture even though dollar sales volume and selling prices are unchanged. Such an effect is likely to result not only from changes in mixture of products, but also whenever there are shifts in the proportions sold in different market areas, through different channels of distribution, or to different classes of customers when these yield different contributions above variable costs. When the cost-volume-profit analysis represents the budget for a specific period the analysis is based upon the sales mix anticipated when the budget is prepared. If the actual mixture experienced differs from that planned in the budget, the effect of such mixture changes is reflected in variances from the budget.

Where it is desired to study the effect on profit of different product or marketing channel mixtures several analyses may be

[6] Sales value of production differs from gross sales when there is a change in the finished goods inventory. However, the two figures may be reconciled if desired. For a discussion of the effect which changes in inventory may have on relationships between cost and volume, see page 525 following.

made, each based upon the assumption of a specific mixture. A discussion of this approach appears later on in this report.

When historical data are being used as the basis for a cost-volume-profit analysis, shifts in sales mixture which have occurred during the period covered by the data may have a serious effect on results obtained. This effect is usually not readily apparent from the over-all sales or profit figures alone and can be traced only by studying detailed sales records. Furthermore, conclusions drawn from an analysis of figures representing a period in which a different sales mixture prevailed cannot be applied to predict performance in the future.

Charting Variation in Revenue with Volume

In plotting the revenue line on a break-even chart, volume is represented by the horizontal scale and revenue by the vertical scale. The variation of revenue with volume is then shown as a line which begins at the zero point on both scales (since no revenue is produced when sales volume is zero) and slopes upward as volume rises.[7] An illustration of the method for charting variation of revenue with volume appears in the Appendix.

In some cases, volume is measured in terms of a physical unit such as tons, pieces, etc. However, in preparing such charts, quantities are ordinarily converted to dollars, since this makes it possible to combine the sales of diverse products to obtain a composite index of volume.

The slope of the revenue line is determined by the unit selling prices, for these govern the rate at which total revenue increases or decreases with changes in volume. Hence a change in selling prices is reflected on the chart by a change in the slope of the revenue line. This is illustrated by Exhibit 4 which appears in the Appendix.

When volume is measured by the sales dollar, both horizontal and vertical scales on the chart are identical and hence the revenue line slopes upward at an angle of 45 degrees from the base of the chart. The effect of a change in selling prices cannot then be shown by the revenue line, but must be reflected in a change in slope of the cost line. The reason for this is that a change in selling price

[7] The equation to this line is $y = bx$ in which y represents total sales revenue, b represents the selling price per unit, and x represents number of units sold.

changes the ratio between variable cost and sales. It is this ratio which determines the slope of the cost line when volume is expressed in sales dollars.

Variation in Cost with Volume

The cost-volume-profit analysis requires determination of the rate at which the variable component of cost changes with volume and also of the amount of fixed cost. Methods for determining how individual cost elements vary with volume have been described in the preceding report of this series[8] and the discussion here is therefore confined to problems which arise in applying such methods for purposes of the cost-volume-profit analysis.

Changes in Inventory

In the preparation of a cost-volume-profit analysis, lack of synchronization between sales and production may raise a problem. Variable manufacturing costs tend to vary with production volume while variable selling costs follow sales volume, and hence the sum of these two classes of costs and also profits tend to fluctuate in an erratic manner when significantly large changes in finished goods inventory have taken place. This difficulty arises because two different indexes of activity are being used—i.e., production for one series of costs and sales for the other. It can be avoided by expressing variations in all costs in relation to the same basis for measuring volume, viz., the sales dollar. The procedure is first to analyze the variation of manufacturing cost with volume of manufacture, measuring the latter in terms of sales value of production. Next the variation of costs other than manufacturing is similarly analyzed, again using sales value of production as the measure of volume. With all costs now expressed in terms of sales value of production as a common denominator, the total cost at any level of activity can be obtained by adding the component costs.

Charting Variation in Cost with Volume

In charting, the cost line is plotted on the break-even chart in a manner similar to that described above for the sales line. Two points are necessary to establish the position of the total cost line, although a third point is often added as a check on the other points.

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[8] See "The Variation of Cost with Volume," Research Series No. 16, *N. A. C. A. Bulletin*, June 15, 1949, Sec. III.

The first of these points is usually determined by the amount of fixed cost and is located on the vertical axis of the chart at the proper dollar value. The second point is located by plotting the total cost (i.e., fixed and variable combined) for a chosen volume. Ordinarily this is either the normal capacity volume or the volume forecasted for the coming period. The cost is that anticipated in the budget for such a volume. A line connecting these two points is then drawn to represent the variation in total cost as volume changes.[9] The procedure is illustrated in the Appendix.

The slope of the cost line is determined by the ratio between sales value of production and variable cost. This in turn is influenced by the basis upon which the amount of fixed cost is determined because this sets the height of one of the points through which the line is drawn. When the chart represents the coming budget period, it is customary to define zero volume as a condition during which the plant is standing by ready to resume production as it might be during a period of a week or two. However, there appears to be a rather wide variation in practice with respect to which costs are expected to continue and the amounts of these costs allowed under such a condition.[10]

On the other hand, some companies plot the cost line on their break-even charts by using costs at two or more volumes within the normal or anticipated range for which cost control budgets are prepared. The slope of the cost line is thus determined by the rate at which cost is expected to vary with volume under usual operating conditions. While the amount of fixed cost is then obtained by projecting the cost line back to the zero volume line on the chart, the resulting fixed cost figure is viewed as more or less theoretical. If a shutdown should occur, the actual amount of continuing cost would be much affected by managerial decisions made at the time.

The area under the total cost line can be divided to show various components which make up the total cost. Thus a line is usually

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[9] The equation to the cost line is $y = a + bx$ in which y represents total cost, a is the amount of fixed cost, b is the ratio of variable cost to volume, and x is the volume.

[10] Two of the companies interviewed reported that they had recently had occasion to compare their fixed cost allowances with actual expenses during strikes which closed the plants for several weeks. In one case actual expenses were close to those expected while in the other case actual expenses were considerably higher than those anticipated because it was found necessary to continue certain maintenance operations in order to keep equipment in condition for use.

drawn to separate the fixed portion from the variable portion. Additional subdivisions of the areas on the chart may be introduced if desired. For example, variable cost may be divided into material, labor, variable overhead, variable selling, and variable administrative expense. However, excessive detail on the chart may obscure significant relationships. Some companies prepare a summary chart which is supplemented by additional charts showing such details as may be wanted. In general, it seems that the break-even chart is best used as a tool to focus attention on critical areas and over-all results. When the study of details is desired, reference to the figures which underlie the chart is usually preferable.

Ordinarily the amount of fixed cost is shown on the break-even chart as a band parallel to the horizontal axis of the chart, but some users of the chart prefer to place the variable cost area at the bottom and thus to show fixed cost as a band parallel to the total cost line. The chart then shows what contribution is made to fixed costs at varying volumes up to the break-even point after the variable costs have been covered. Those who use the latter type of chart do so because they consider it to be more in accord with the reasoning which underlies the chart. Illustrations of these two types of break-even charts appear in the appendix as Exhibits 1 and 2.

Significant Cost-Volume-Profit Relationships

When the cost and revenue curves which represent a company's cost structure for a given set of conditions have been established as described above, it is then possible to study the significant cost-volume-profit relationships. In order to do this, it is usually desirable to work with numerical values for items shown graphically on the chart.

Amount of Fixed Cost

Where fixed costs are high, fluctuations in volume result in wide fluctuations in profit. On the other hand, a business which has relatively low fixed costs usually displays somewhat narrower swings in its profits as volume varies.

Improvement of profits through an attack on fixed costs may be made by either a reduction in the amount of fixed costs, an increase in volume to reduce the expense rates, or both. Modifica-

tion of long-term fixed costs ordinarily requires long-range planning based upon forecasts of volume for some years ahead. In some cases this takes the form of directing new investment in plant and equipment toward improving manufacturing facilities for the products which are expected to grow in volume or to be most profitable in the future. In other cases it means acquisition of new equipment which reduces unit cost by increasing output. On the other hand, costs which are fixed only by readily changeable decisions of management would seem to be a particularly fruitful field to study for possible reductions when a marked drop in volume has affected profits adversely.

However, it should be remembered that low fixed costs are not by themselves an indication of a good profit structure for many of the most important approaches to cost reduction require increases in fixed costs in order to effect savings in variable costs or additions to sales revenue.

Variable Cost

Variable cost is usually expressed as a percentage of the sales dollar when volume is measured in terms of sales value of production. When the variable cost ratio is known, the amount of variable cost at any volume within range of the analysis is readily calculated. Unlike the ratio of fixed cost to volume, the ratio between variable cost and volume is constant so long as factors other than volume remain unchanged. However, changes in wage rates, prices paid for materials, labor efficiency, and similar changes in unit variable costs affect the variable cost ratio.

Marginal Income Ratio and Marginal Balance

Another figure, which is perhaps one of the most significant derived from the analysis, is the marginal income ratio. It is the percentage of the sales dollar available to cover fixed costs and profits after deducting the percentage required for variable costs. The marginal income ratio is readily calculated by subtracting from 100 per cent the ratio which variable cost bears to sales. In other words, the marginal income ratio is the complement of the variable cost ratio. It is a constant figure for all volumes within range of the analysis.

The excess of sales revenue over variable cost, or the marginal balance, can be determined for any given sales volume. Since this figure is a dollar amount rather than a ratio, it is different for each

volume. It is interpreted as the number of dollars available to cover fixed costs and profit after subtracting variable costs from sales value of production.

The marginal income ratio determines the increase or decrease in profit which can be expected from changes in volume provided no change occurs in any other factors. Thus some companies show a large increase in profit from a comparatively small increase in volume while other companies require a large increase in volume to yield a significant change in profit. For example, assuming present sales volume to be above the break-even point, an increase of $500 in sales yields an addition to profits of $300 if the marginal income ratio is 60 per cent, but only $100 increase in profit if the marginal income ratio is 20 per cent. In terms of the break-even chart, the angle between cost and revenue lines is wide for companies in the first category, while for companies in the second category the angle is narrow. Knowledge of this fact would seem to be useful in developing sales strategy. For example, a high marginal income ratio indicates that comparatively large additional expenditures for advertising and selling directed toward obtaining added sales volume may be profitable because the margin available from such sales is adequate to absorb the expenditures and still leave a contribution to profits.[11] However, it should be recognized that additional expenditures for sales promotion may bring similar intensification of competitors' selling efforts which partly or wholly cancel the advantage gained. As an alternative, price reductions might be used if sales volume responds readily to price changes, although here again action should not be taken without considering the probable action of competitors. Reductions in price required by competition can also be absorbed more readily by a company having a high marginal income ratio. Since changes in variable cost also affect the marginal income ratio, this ratio indicates how readily the business can absorb cost increases without serious loss of profit.

When the marginal income ratio is known, it is possible to ascertain what effect the addition or the loss of a given block of business will have on the company's marginal balance and thus on its profit. If the company is already operating at a volume above that needed to break even, the contribution to marginal balance made

[11] For example, see G. Charter Harrison, "The Practical Economist's Profit and Loss Statement," *N. A. C. A. Bulletin*, December 15, 1948.

by additional sales tells directly how much these sales add to net profit. For example, using the following data:

	Present volume	*Additional volume*
Sales	$6,000	$1,000
Variable costs	3,900	650
Fixed costs	1,470	—
Total cost	5,370	650
Operating profit	$ 630	$ 350

The same result can be obtained by multiplying the additional sales figure by the marginal income ratio:

$1,000 times 35% = $350.

In making the above calculations it is assumed that the same marginal income ratio which applies to the present volume can also be applied to the additional volume. However, if the additional goods sold or projected to be sold have different costs or selling prices, it will be necessary to calculate the marginal balance on the new business according to the facts of the situation.

If the company is operating below its break-even volume, the addition to marginal balance constitutes a reduction in net loss or changes a loss into a profit. Decreases in sales have the opposite effect in each case since the change in marginal balance is then negative. In any case, once the rate of marginal income is known, the change in profit occasioned by any given increment in sales is readily calculated by multiplying the increase or decrease in sales by the marginal income ratio applicable to the specific type of business.

Operating Profit

Since profit is the difference between cost and revenue, the area between the cost and revenue lines on the chart represents profit where the revenue line is above the cost line and loss where the revenue line lies below the cost line. The amount of profit or loss at any given volume can be read from the chart as the vertical distance between the two lines. Owing to the presence of fixed costs, both the amount of profit and the ratio between profit and sales vary with sales volume. Thus a single period's profit and

loss statement does not provide the basis for predicting what profit before taxes would be at a different volume of sales.

Another type of chart is sometimes used to display the relationship between profit and volume. In this chart the profit figures at different volumes are plotted to give a single line representing the variation of profit with volume.[12] An illustration of this chart appears in the appendix as Exhibit 3.

A break-even chart in this form has the advantage of simplicity in that only one line is required. Where it is desired to focus interest on the variation of profit with volume this chart may be preferable because it is easier to follow the relationship when it is presented as a line than when presented as an area as on the preceding chart. However, it does not show the cost and revenue lines and hence is less informative. At times it may be advantageous to employ both charts together, using the first chart to present facts about the manner in which costs and sales revenue vary with volume and the second chart to show the resulting effect on profit.

The field study indicated that cost-volume-profit analyses ordinarily do not take income taxes into consideration. However, such taxes are an important factor in many managerial decisions which involve relationships between profit and volume.

Income taxes reduce the profits which would otherwise accrue to the company from additional volume or from cost savings. Losses may be used to reduce taxes of prior or subsequent years. In charting cost-volume-profit relationships using the types of charts shown in the Appendix as Exhibits 1 and 2, income taxes can be shown by drawing a line to divide the profit area into two portions representing, respectively, income taxes and profit after

[12] The equation to the profit line in this chart can be obtained algebraically by subtracting the cost line equation from the revenue line equation. Thus, assuming that costs are composed of a $40 fixed portion plus 60 cents a unit variable and that selling price is $1.00 per unit:

Revenue	=	$1.00 x
Cost	=	$40. + .60 x
Profit	=	−$40. + 0.40 x

The profit line then starts at −$40, or the amount of the fixed cost which is also the amount of the loss at zero volume. As volume is increased, the loss decreases by $0.40 for each added dollar of sales up to $100 (i.e. the volume at which the company breaks even) and beyond that point each added dollar of sales volume adds $0.40 to the company's profit. The line on the chart is sometimes called the P/V line since the slope of the line represents the change in profit which accompanies a given change in volume.

taxes. The loss area can be similarly divided to show losses recoverable through reduction of taxes in other years and the net loss after such recovery. When the type of chart illustrated in Exhibit 3 is used, profits or losses are charted after reduction for taxes paid on profits or recovered through carrying losses forward or backward. The result is a profit line which shows profits or losses after taxes at various volumes.

Break-Even Point and Margin of Safety

The break-even point indicates the volume of sales which the company must obtain in order to cover its cost without profit. On the type of break-even chart usually used, it falls at the point where total cost and revenue lines cross. The dollar figure at which the company breaks even can be calculated by dividing the amount of fixed cost by the marginal balance expressed as a percentage of the sales dollar.[13]

Used as a figure for comparison, the break-even point adds significance to current sales data. The excess of actual or budgeted sales over the break-even sales volume is sometimes called the margin of safety. The margin of safety indicates the drop in sales volume which can take place before profits disappear. The trend in the ratio between sales volume and break-even point also furnishes an indication of fundamental changes affecting the ability of the company to make a profit. However, it is important for management to know what the conditions are which have caused the change in this ratio before drawing conclusions or planning action. For example, the break-even point varies up and down directly with the amount of the fixed cost and inversely with the margin per unit of selling price over variable cost.

Computations of the changes in break-even point which will result from proposed or anticipated changes in costs and selling prices may sometimes be used to advantage. This approach is in some respects more informative than the widely used comparison

[13] The formula is ordinarily stated as:

$$\text{Break-even point} = \frac{\text{Fixed costs}}{1 - \frac{\text{Variable costs}}{\text{Sales}}}$$

Its application may be illustrated as follows, using data from the budgeted income statement given in the appendix:

$$\text{Break-even point} = \frac{\$1{,}470{,}000}{1 - \frac{\$3{,}900{,}000}{6{,}000{,}000}} = \$4{,}200{,}000$$

of total unit costs of product because the latter are necessarily based upon the assumption that a specific volume will be produced. Estimates of cost savings or profits based on such unit costs are valid only for the production volume chosen to apply fixed costs to the product. On the other hand, a computation of the effect which the change will have on the break-even point and on the marginal income ratio is valid for any volume within normal limits.

There is reason to believe that the significance of the break-even point has been overemphasized, or at least that other statistics derived from the cost-volume-profit analysis are more useful. While the effect of changes in prices, manufacturing facilities, etc., can be conveniently illustrated by determining how they shift the break-even point, it may be more important to management to know what effect such changes will have on profits at the present or anticipated volume of sales.[14] Moreover, where the break-even chart is based largely on experience at volumes well above the break-even volume, fixed costs are usually somewhat greater than they would be if volume should drop to or near the indicated break-even level. If it seems likely that volume will remain low for a considerable time, most companies revise their budgets to reduce fixed costs and thereby lower their break-even point.[15]

Analysis of Cost-Volume-Profit Relationships by Products

Many decisions in business planning require information about costs of making and selling individual products. When the type of cost-volume-profit analysis described above is extended to determine how costs vary with volume for each product or each group of like products, management is better able to appraise the effect on over-all profit which may be anticipated from changes in the relative volumes of the different products made and sold. Such information is especially important in directing selling effort into the most profitable channels by deciding which products should be emphasized, which ones should be sold only because they contribute toward absorption of the fixed overhead, and which ones might advantageously be discontinued or replaced with something

[14] The field study disclosed a company whose president had rejected information about the company's break-even point on the grounds that it was not significant to executives who should be concerned with maintaining conditions under which the company would operate at a profit.

[15] One company thus reported that during the period 1929-33 it reduced many fixed expenses by percentages which exceeded the percentage reduction in total variable costs.

more profitable. Similar data can be developed to reflect the effect on profits of changes in volume sold through various marketing channels.[16]

Moreover, there are many cases where wide differences in products and methods with which they are made and sold make it impossible to combine them without destroying the significance of the resulting figures. While cost and sales data expressed in dollars can be added together, the aggregates thus obtained may be representative for none of the components. Under these conditions it is necessary to make separate analyses for groups of products which are reasonably similar.[17] Such analyses of cost-volume-profit relationships are ordinarily made by product lines rather than for each individual product. This procedure reduces the amount of clerical work needed in preparing the analyses and usually improves reliability of the results. The reason for the latter is that individual plants within a company are often devoted to an individual product line and the need for allocating costs of facilities shared with other products is thereby kept to a minimum.

Procedure in Analyzing Cost Variation by Products

In order to ascertain the rates of marginal income by products, it is necessary to determine how the cost of each product varies with changes in volume. The same general methods previously described for measuring variation of cost with volume are applicable to costs of individual products or product lines as well as to overall costs. When the variability of each of the different classes of costs is known, a break-down by products can be prepared on the basis of the usage of the various cost factors in producing and selling individual products. It is, of course, unnecessary to allocate the fixed costs to products for the purpose of calculating rates of marginal income by products, for those costs which do not vary with volume do not affect the marginal income ratios.

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[16] Examples of such analyses made by companies interviewed in the field study include determination of cost and profit variation with volume by sales territories, delivery routes, marketing channels, sales outlets, salesmen, and individual sales contracts. The number and variety of such analyses made depend upon the methods of marketing used by the company in each case.

[17] Several companies stated that they find it practically impossible to make analyses by individual products because there is no separation of factory facilities and the same operations may be performed in any one of a number of places in the plant according to the combination of other jobs scheduled at the time.

On the other hand, determination of product line break-even points does require assignment of fixed costs to the individual product lines. The reliability of the resulting break-even points is heavily dependent upon the manner in which the fixed costs are assigned to the individual product lines. Where separate plants and separate sales organizations are maintained for the various product lines, it is not difficult to obtain reliable break-even points because most of the fixed costs can be readily identified with an individual product line. However, where a significant portion of the facilities represented by the fixed costs is shared in common by the various products, difficulties which are inherent and cannot be readily overcome cause the resulting break-even figures to have only limited reliability in many cases. This is especially true of fixed selling and administrative expenses which must be allocated on more or less arbitrary bases.

The field study showed that most companies prefer to consider the problem from the standpoint of the marginal income contribution of product lines toward aggregate fixed costs. Marginal income ratios for individual products or product lines can usually be developed since allocation of common costs is not necessary for this purpose.

A confusing problem which often appears in the determination of break-even points by product lines arises from the product mix factor. When the individual product break-even points are added, their sum differs from the break-even point calculated on an over-all basis unless the sales figure for each product line bears the same percentage to total sales as the individual product break-even point bears to the over-all break-even point.[18]

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[18] This may be illustrated with the following hypothetical figures:

A business with three products has calculated break-even points for the individual products as follows:

	Product				
	A	B	C	Totals	
Sales	$30	$25	$80	$135	
Variable costs	12	10	60	82	
Fixed costs	6	30	10	46	
Break-even sales	10	50	40	100	(by cross-footing)
				117	(by computation from totals above)

The break-even point calculated on an over-all basis is found to exceed the break-even point obtained by summing individual product break-even points. However, if sales of each product have been at the break-even volume for that product, individual break-even points could be cross-footed

Interpretation of Cost-Volume-Profit Analyses

Volume is only one among many factors which cause costs to vary. Sales figures are likewise affected by such nonvolume factors as unit prices and mix. In order to study the variation of costs and profits with volume it is necessary to assume that factors other than volume remain constant during the period for which the analysis is applicable. Break-even points which are quite different can be obtained by varying these underlying assumptions and each of these break-even points is equally valid for the specific assumptions made.[19] Hence it is important to keep these assumptions in mind, for conclusions drawn from a cost-volume-profit study must

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to obtain the break-even point based on total sales of the three products combined as illustrated below.

	Product			
	A	B	C	Totals
Sales	$10	$50	$40	$100
Variable costs	4	20	30	54
Fixed costs	6	30	10	46
Sales to break-even	10	50	40	100

The reason for the difference between the two sets of figures lies in the fact that the sales mix is not the same. Thus, in the first example, the products are sold in proportions of 22%, 19%, and 59%, whereas in the second they are sold in proportion of 10%, 50%, and 40%. When total sales differs from the break-even volume but the distribution among the three products is in the same proportions of 10%, 50%, and 40%, the individual product break-even points add up to the over-all break-even point as shown below:

	Product			
	A	B	C	Totals
Sales	$20	$100	$80	$200
Variable costs	8	40	60	108
Fixed costs	6	30	10	46
Sales to break-even	10	50	40	100

The effect of such changes in mix is exerted on the break-even point through changes in the over-all marginal income ratio. Unless individual product marginal income ratios are weighted by sales figures in the ratio of the individual product break-even volumes, a different over-all marginal income ratio and hence a different over-all break-even point results.

[19] As an example, independent calculation of the break-even point by two individuals in the same company yielded figures one of which was almost double the other. The lower figure gave effect to the increased efficiency, elimination of overtime, and other cost reductions which were expected if volume should drop from the then current high level to a level nearer the break-even point. The higher figure made no allowances for such changes, but assumed costs would continue at the same rates experienced with volume at a high level.

always be interpreted and applied within the limitations of such assumptions.[20]

A given break-even chart is based upon a given set of conditions which are expected or assumed to exist for the time the chart is to be used. As stated above, the budget is usually the source of data from which the break-even chart is prepared and hence the chart represents the conditions forecasted or planned when the budget was set up. As such, a break-even chart is a basis toward which to work rather than a picture of the company's actual profit structure at any one time. In actual circumstances, the underlying non-volume factors are seldom stable for long and it is therefore necessary to revise the figures derived from previous analyses of cost-volume-profit relationships and to draw new break-even charts. The field study indicated that most companies do this for each budget period or whenever the budget is revised.

Under conditions of particularly rapid change break-even charts may become obsolete too soon to justify their preparation. With respect to this, one company made the following statement:

> "During the past four years we have increased our productive capacity with plant additions and our selling capacity with additional branch offices. We have introduced new models, worked a lot of overtime, and started an employee pension plan. These and other changes in operating conditions required frequent revisions in financial forecasts of costs, expenses, profits, and cash. This in turn changed our break-even point quite often.
>
> "We have continued to give management figures on break-even volume during the period of expansion based on the estimates made in the financial forecasts. We often refer to these figures as the break-even area and point out that the actual break-even point may be plus or minus ten per cent of the break-even volume submitted. It would have been unwise and impracticable to have prepared a chart during the past few years."

Another company does not prepare a break-even chart because

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[20] For example, it is entirely possible to lose money on a volume well above the break-even volume if costs are allowed to increase beyond the level anticipated when the break-even chart was drawn, if the expected selling prices are not obtained, or if sales shift too heavily to low margin items.

large expenditures for advertising and sales promotion which have a material effect on costs and profits cannot be foreseen. In this company these expenditures are not planned for a budget period but are made whenever management considers them desirable or necessary in the light of competitive conditions.

Nevertheless, cost-volume-profit analysis methods may be very useful in studying the results of various changes in factors other than volume.[21] As stated by one accountant, the technique of cost-volume-profit analysis helps provide answers to many questions which begin with "What would happen if ——?" In fact, the cost-volume-profit analysis itself often brings out the need for certain changes in order to protect or to improve the company's profits. For these purposes, it is useful to have an understanding of the effect which changes in the principal factors will have on the company's profit structure.

Changes in Amount of Fixed Cost

A change in the amount of fixed cost changes the break-even point by an equal percentage provided all other factors remain the same. The profit figure at any given volume is changed by the amount of the increase or decrease in fixed cost, but the marginal income ratio remains the same. Thus, if fixed costs are $1,470,000 and variable costs are $0.65 per dollar of sales, an operating profit of $630,000 results from a sales volume of $6,000,000. If fixed costs are decreased to $1,176,000 or by 20 per cent, variable costs and sales volume remaining the same, the profit increases to $924,000. Profits have risen by exactly the amount of the decrease in fixed cost. On the other hand, the break-even point drops from $4,200,000 to $3,360,000, or by 20 per cent. A chart showing the effect of a change in fixed costs appears in the Appendix as Exhibit 5.

However, changes in fixed costs are commonly accompanied by changes in variable costs and sometimes also by changes in selling prices. Thus increased mechanization of operations usually increases fixed costs although savings in variable costs are often an important objective of such changes. The break-even volume may

[21] One of the companies interviewed stated that the physical volume of its principal products is comparatively stable and that it would have little use for a break-even chart based upon volume. However, fluctuations in the price of its main raw material have an important effect on profits and it has prepared a table showing the variation of profit with price paid for this raw material.

be either higher or lower following such a change in costs. If the break-even point is raised by greater fixed costs, it may be desirable to consider the probability that sufficient volume at an adequate price can be obtained, for otherwise the expected improvement in net profit may not materialize.

Where future volume is uncertain, it may be advisable to consider such means as subcontracting, purchase of parts needed, renting additional space, hiring more employees, or some similar arrangement for meeting temporary peaks in sales without adding plant and equipment which would increase the fixed costs and thereby decrease the company's ability to adjust its costs to lower volume. On the other hand, an increase in the break-even point caused by acquisition of equipment or personnel which reduces variable costs or improves product quality may be highly advantageous where sufficient volume is available. Relationships between costs, volume, and profits are sometimes altered substantially by changes of the type here described and the various tools of cost-volume-profit analysis may be highly useful in studying proposals under consideration by management.

Opportunities for reduction of fixed costs should not be neglected in a cost reduction program. That the fixed costs are fixed only by decisions which management has made was pointed out in the preceding study. Hence by changes in these decisions, it is often possible to reduce costs. The field study showed that it is common practice to review the more readily controllable fixed costs each time a new budget is prepared. When volume drops below the range covered by the cost control budgets, most companies probably reconsider many fixed costs which were established on the basis of higher volume. By thus reducing fixed costs, the margin between cost and selling price is widened at any volume and the break-even point is lowered, thereby enabling the company to withstand a greater drop in volume before net profit vanishes altogether.

Changes in Variable Cost

Changes in unit variable costs change both the marginal income ratio and the break-even point. On the break-even chart, such changes alter the slope of the total cost line and also affect both the profit area and the location of the break-even point. Thus, if the variable costs are increased from 65 cents to 70 cents per dollar

of sales, the portion of each sales dollar available for meeting fixed costs is decreased from 35 cents to 30 cents with the result that an increased number of sales dollars will be needed to reach the break-even point.

Variable costs are determined principally by such factors as prices and wage rates paid, operating efficiency, product specifications, manufacturing and selling methods. Hence attempts to modify cost-volume-profit relationships by changes in variable costs must be made through these factors. The possible approaches are numerous and generally familiar. For example, they include measures to reduce material scrap and waste, employee training and incentive payment plans to improve efficiency, better production planning, revised shop layout, etc. As pointed out above, changes made to reduce variable costs frequently increase fixed costs and it is then necessary to consider the net effect on profit over the expected range of volume. The techniques of cost-volume-profit analysis may be used to advantage in studying such problems. This application is illustrated in Exhibit 6.

Experience indicates that some variable costs which are very difficult to control in periods of high volume can more readily be reduced when volume drops. For example, one company reported that its repair and maintenance costs had declined when lower volume allowed equipment to be shut down for periodic preventive maintenance and another company stated that shipping and transportation costs dropped after it was able to build up an adequate inventory of finished goods so that orders no longer needed to be shipped in installments. Such opportunities tend to increase in number when many companies are experiencing a similar drop in volume, for then savings may be realized from lower prices and better quality materials, lower turnover of labor, and better availability of services and new equipment. As offsetting influences, it may be necessary to reduce selling prices, to sell a larger portion of low margin products, and to spend more for selling.

In the interpretation of break-even charts, it needs to be remembered that any given chart is based upon the assumption that variable costs will increase or decrease with volume. However, many of these costs are not automatically variable with volume and do not follow volume closely unless management exercises control over them. Where such control is lacking or is not effective, actual profits may differ from those indicated by the break-

even chart. For this reason a good plan of day-to-day cost control seems necessary if plans based upon the cost-volume-profit analysis are to be realized.[22]

Changes in Selling Price

Changes in selling prices change the ratio of variable costs to sales and consequently alter both the break-even point and the marginal income ratio. In this respect a change in selling price has an effect which is the opposite of a change in variable cost. However, the marginal income ratio is more sensitive to a change in selling price than to a change in variable cost because changes in selling price change the base upon which the marginal income ratio is computed. Thus, in the following example a price reduction of ten per cent is equivalent to an increase of 11.1 per cent in variable costs when the effect of the change on the marginal income ratio and break-even point is considered.

	Budgeted profit structure		*After 10% reduction in selling prices*		*After 11.1% increase in variable costs*	
Sales value of production	$6,000,000	100.0%	$5,400,000	100.0%	$6,000,000	100.0%
Variable cost	3,900,000	65.0	3,900,000	72.2	4,332,000	72.2
Marginal balance	2,100,000	35.0	1,500,000	27.8	1,668,000	27.8
Fixed cost	1,470,000	24.5	1,470,000	27.2	1,470,000	24.5
Operating profit	630,000	10.5	30,000	0.6	198,000	3.3
Break-even volume	$4,200,000		$5,287,613		$5,287,613	

Under some circumstances it may be possible to introduce lower priced lines of merchandise which do not compete seriously with existing products. So long as such products make a contribution to the marginal balance, the company's net profit will be increased. Similar results can sometimes be obtained without reducing prices by extending market coverage to territories or classes of customers that return a lower margin because selling and distribution expenses are greater than in the present market. Again the added volume will increase net profit so long as such sales make a con-

[22] A later report in this series will include a discussion of budgetary methods to aid control of costs under conditions of varying volume.

tribution to the marginal balance. However, it is usually desirable to consider the possible long-range effects of such actions, for a decision which is advantageous for a short period may ultimately bring competitive retaliation or other reactions affecting prices and volume of other products or in other markets.

Changes in Sales Mixture

Where sales revenue is a composite figure made up of sales of several products having different individual marginal income ratios, the over-all profit-volume relationship changes with changes in the proportions in which the various components are present. Thus while the budgeted volume of sales may be met, the profit may fall below that expected if the proportion of low-margin goods sold exceeds that anticipated. Exhibit 7 illustrates a change of this type. Where sales are made in different markets or through different channels in which the marginal income ratio varies due to differences in costs of selling and distribution, the same effect may come from shifts in relative sales volumes in the different markets. Such mixture changes in sales alter both the break-even point and over-all marginal income ratio of the company. As stated by one of the companies interviewed:

> "In constructing break-even charts, the figures must be developed on the basis of normal production of various products and as volume decreases, it must be assumed that the decrease is shared proportionately by the various products. This is not always the case and when the volume of various products manufactured decreases by different percentages, there may be a very significant change in the break-even point. In cutting back production, certain sizes of our product were reduced to a greater extent proportionately than other sizes and there was a considerable change in the break-even point."

Hence a break-even chart represents a given sales mixture and when this mixture changes, the chart must be revised to reflect the new assumptions as to sales mixture.

Some companies have found it possible to improve both profits and break-even point position through actions prompted by study of sales mixture. Several possible courses of attack are possible here, viz.:

1. Direction of sales effort toward increasing the proportion of high-margin products sold.
2. Changes in products or manufacturing methods which increase the profit margin by decreasing costs.
3. Revision of selling prices. It may be found desirable to increase prices to provide a better margin on some products if that can be done without affecting sales volume while price reductions on other products may benefit profits by increasing the number of units sold.

Application of Cost-Volume-Profit Analysis

The cost-volume-profit analysis appears to be useful principally as a technique for the study of problems encountered in business planning. As such, it is a tool used largely by those executives responsible for strategic planning and policy making. Charts and other summaries of cost-volume-profit relationships are also used as educational devices to acquaint various employees with the principal factors which affect the company's profits.

Applications in Profit Planning

The primary value which the cost-volume-profit analysis has in planning arises from the ease with which volume can be treated as a variable rather than as a fixed factor. Thus a budget based upon a sales forecast provides a prediction of profit only for the forecasted volume. If it is desired to determine what effect a change in volume will have, an entire new budget must be prepared. On the other hand, where the relationships between cost, volume, and profit have been determined, profits can be predicted for any volume within the range of the analysis. The field study indicated that such an analysis is usually prepared in connection with the budget for a forthcoming period and a break-even chart is drawn to present the principal relationships. By study of these relationships in connection with the budget, management can better appraise the profit plan which the budget represents. Several of the companies interviewed stated that they prepare cost-volume-profit analyses from preliminary budget figures and, when the profit structure thus indicated is not satisfactory to management, changes are made where possible before the budget is approved. The following quotation describes the general procedure:

> "The line executives are now in a position to decide intelligently on their course of action if they are not satisfied with the goals indicated in our profit and loss budgets. They may decide, for example, to try to increase sales volume. In this event, a further study would be made to determine what additional facilities are required, what the effect on our fixed costs would be, how much the added fixed costs would increase our break-even sales, and whether or not our return on investment would be improved. Or they might decide that our break-even point is dangerously high in relation to sales possibilities and that we should revamp our organization to effect a reduction in nonvariable expenses which in turn will reduce our break-even point."[23]

Other companies prepare break-even charts or statements based on their master budget figures as general background for top management.[24]

Discussion during the field study seemed to indicate that accountants rather generally agree that the principal significance of the break-even chart lies in the help that it gives top management in understanding and in visualizing the effects of changes in costs, prices, and volume on profits. Since operating executives are ordinarily not extensively trained in accounting, a clear and nontechnical presentation of such relationships can be a distinct aid to better decisions. As expressed by the controller of one company:

> "The break-even chart is a summary of the budget as a whole and the planning that goes into it. The chart and various relationship figures such as the break-even point are merely convenient ways of expressing relationships existing in the budget. However, these devices make the executives more conscious of the relationships between cost, volume, and profits and give them valuable background for plans which involve these factors."

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[23] "Finding and Controlling the Break-even Point," Nicholas St. Peter, *N. A. C. A. Bulletin*, June 1, 1948, pp. 1214-1215.

[24] As an example, one company has developed a schedule showing:

1. Profit per dollar of sales above the break-even point.
2. Loss per dollar of sales below the break-even point.
3. Added sales dollars needed to offset each additional dollar of expense.
4. Reduction in expense necessary to offset each dollar decrease in sales.

Various tools of cost-volume-profit analysis are often useful in connection with planning problems other than budgeting. Here it is desirable to distinguish between long-range and short-range purposes. In addition, it is often necessary to make special studies of cost variability.

Long-Range Problems

Long-range problems center primarily around those costs which are fixed for shorter periods, but which are variable with volume over a longer time. Such costs are largely those connected with the provision of long-lived assets, although costs of developing new products, methods, and markets are important to some companies. The purpose of cost-volume-profit anlyses here is usually to study the probable effect on costs and profits of proposed plans involving investment in new plant and equipment. A few companies were found to prepare break-even charts reflecting average conditions for a period of years, but these seem to be distinct exceptions to the general practice.[25] More commonly, special analyses are made when an individual problem arises.[26]

Short-Range Problems

Short-range problems to which cost-volume-profit analysis techniques are applicable include current appraisal of progress toward the annual budget goals and short-period tactical decisions in the direction of sales effort and in pricing.

The field study showed one company that prepares its monthly profit and loss statement in the following form:

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[25] Thus one company uses such a chart to represent average costs over a business cycle. Another company prepares such a chart for a five-year period. These charts were stated to be of interest to management in planning because they display the variation of cost over a period long enough for the so-called "policy fixed" items such as salaries to be adjusted for volume changes. One of these companies was also interested in showing how a program of equipment modernization which would take several years to complete would ultimately affect the company's profit structure.

[26] As an example of such use, a company acquired a run-down plant to help increase its output during the war. It found that the plant could not be operated profitably under peacetime conditions. After a study of various possibilities, a plan for rehabilitation was developed and the company's cost accountant was asked to prepare a report on probable costs of operating under the proposed plan. Since these costs would vary with the volume of production, he used a break-even chart to present the results of his calculation.

Sales		xx
Variable cost of sales:		
Labor	xx	
Material	xx	
Variable overhead	xx	xx
Variable selling expense	xx	
Gross margin before fixed charges		xx
Fixed charges:		
Factory fixed expense	xx	
Selling expense	xx	
General and administrative expense	xx	xx
Net operating profit		xx

A break-even chart is not prepared[27] but the above statement shows what margin is available to cover fixed charges and what the amount of these fixed charges is. From these data the sales volume necessary to cover the fixed charges and produce a satisfactory profit is readily determined by management. The statement also shows when action is needed to increase sales or to reduce costs in order to preserve profits. From the statement in this form management can see directly what effect given changes in sales or costs will have on the company's profit. By including the budgeted profit and loss statement a comparison between expected and actual performance is also provided.[28]

In contrast with this form of profit and loss statement, the conventional profit and loss statement requires much analysis to interpret and the reasons for many changes cannot be readily determined from the statement or from comparative statements by themselves. For example, it may be found that when the statement for this month is compared with that for last month, the current month's sales and profit figures are both lower, but that profit has dropped considerably more than sales. From the type of statement illustrated above, it can be seen (1) that some costs are fixed and

[27] A number of other companies achieve somewhat similar results from the use of break-even charts. Thus monthly break-even charts based on actual performance are drawn and compared with similar charts based upon the budget.

[28] The above profit and loss statement treats fixed costs as period costs. While the company finds it advantageous to do this in the statement prepared for internal management in directing the business, this practice is contrary to generally accepted methods of financial reporting. Hence, for the latter purpose an adjustment is made to include the applicable portion of fixed costs in inventories.

hence could not be expected to decline proportionately with sales, and (2) whether or not the variable costs which should have been reduced in proportion to sales were actually controlled. Unless the relationships between cost, volume, and profits are known, such a situation cannot be clearly explained.

Numerous examples of the marginal income approach to short-range problems in the direction of sales effort and in pricing were encountered in the field study. As an example of the first, one cost accountant stated that he was frequently asked to determine what additional monthly sales volume would be required to justify employment of an additional salesman, to send sales representatives into a new area not previously covered, or to maintain a local warehouse stock instead of making shipments from another city. The additional costs which were expected to result from the change were compared with additional sales revenues for the purpose of guiding management in such decisions.

In other cases the contribution which a given product or order would make toward fixed costs and profit after variable costs had been deducted was stated to be an important consideration in pricing, especially when the company had some unused production capacity available.[29] However, the same approach was also used in some cases to select the products which contributed the most to profit in order that these might be stressed in advertising and selling. This is illustrated in the following statement received in the course of the field study.

> "In our reports to management, we have been stressing the importance of setting price and volume combinations which produce the best profit. The cost department has been called upon to prepare figures showing marginal profits likely to be realized on individual models at different prices and volume levels. We take every opportunity available to point out the profit-making opportunities in selective selling."

When using such costs as the basis for pricing or for deciding what business to accept, it needs to be borne in mind that costs which are appropriate for one period of time may not be appropriate for a longer or shorter period. The reason for this is that,

[29] For a discussion of this approach, see "When Is Selling at a Loss Profitable Business Policy," Walter B. McFarland, *N. A. C. A. Bulletin*, Nov. 1, 1939.

when the period is short, many costs are fixed which become variable over a longer period. Thus profits may be increased temporarily by accepting a class of business which more than covers short-period variable costs, but if the cost computation is made for a longer period the same business may be unprofitable."[30]

Educational Applications

Many of the companies interviewed reported that information about the variation of cost and profits with volume had been valuable in making the managerial organization conscious of the need to do a certain volume of business and to control costs in order to attain profit objectives. The value of such information to top executives was generally accepted. On the other hand, a limited number of companies had also used break-even charts and occasionally other devices to acquaint foremen and other supervisory employees with the behavior of costs and profits under conditions of varying volume.[31] In most of these cases, break-even charts were prepared and used in training programs or in explaining objectives of cost reduction programs.

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[30] For example, one company stated that it solicits subcontract work for other manufacturers during periods when sales of its own products do not fully utilize the plant, but that such work cannot be carried on regularly without expansion of its plant. The profit margin on subcontracts is not sufficiently large to cover these additional costs and hence work is accepted only when other business is lacking. The same company sometimes meets a period of high volume by purchasing parts or having them made by subcontractors. While the cost of such parts is usually higher than the cost to make them in the company's own plant, the additional cost is less than it would be if they were made on equipment which could be used only part of the time.

[31] As an illustration, one company regularly prepares a break-even chart for each plant to aid in demonstrating to plant managers and foremen the importance of volume and costs in profitable operation of the plant.

Appendix

Illustration of Calculations and Methods of Charting Principal Cost-Volume-Profit Relationships

The following material has been developed in order to illustrate calculations required in obtaining some of the principal cost-volume-profit relationships discussed in the preceding pages of this report. Methods of charting described in the report are also illustrated.

As a basis for development of additional statistics and charts, the following hypothetical budgeted income statement is used. In this statement costs have been broken down into their fixed and variable components.

X COMPANY

Budgeted Income Statement For 1950*

($000 omitted)

	Total	Fixed costs	Variable Costs	
			Amount	Per cent
Sales value of production	$6,000			100.0
Manufacturing cost	4,192	560	3,632	
Administrative expense	474	425	49	
Selling expense	704	485	219	
Total operating costs.....	$5,370	$1,470	$3,900	65.0
Profit before income tax.....	$ 630			
Marginal income ratio				35.0
Marginal balance			2,100	
Break-even sales volume..... ($1,470 ÷ .35)	$4,200			

*Adapted from Charles H. Gleason, "The Break-Even Point of Operations," unpublished address before Providence Chapter, National Association of Cost Accountants, November 15, 1948.

Graphic presentation of the cost-volume-profit relationships which underlie the above operating statement is shown in Exhibits 1, 2, and 3. These three charts were prepared from the same data and illustrate three different types of break-even charts in common use. In all three charts, sales value of production is employed to measure volume on the horizontal scale. Sales value of production is here assumed to represent the budgeted sales mix and budgeted unit prices.

In Exhibits 1 and 2 the revenue line is plotted by use of three points, namely, (1) zero volume at which revenue is also zero, (2) the budgeted revenue of $6,000,000 at the forecasted volume of $6,000,000, and (3) the revenue which would be produced at plant capacity assuming the same prices and mix, viz., $7,000,000. The amount of fixed cost ($1,470,000) is taken directly from the budgeted income statement. Variable costs at three volumes are also employed in plotting. These three points are: (1) zero volume at which variable cost is also zero, (2) the budgeted variable cost, $3,900,000, at the budgeted volume of $6,000,000, and (3) the expected variable cost at plant capacity volume of $7,000,000, which is determined by multiplying sales value of production at plant capacity volume by the variable cost ratio (i.e., $7,000,000 x .65 = $4,550,000).

Exhibits 1 and 2 differ only in that fixed cost is placed at the bottom of the chart in Exhibit 1 while in Exhibit 2 variable cost is placed at the bottom. Exhibit 3 shows only a single line which represents variation in operating profit with volume. Three points were used to plot this line, viz., the amount of fixed cost ($1,470,000) which is the amount of loss at zero volume, the break-even figure which is the point where the profit line crosses the zero profit line (i.e., at sales of $4,200,000), and the operating profit at the budgeted volume ($630,000).

Exhibit 4 shows the effect of a change in selling prices. If a reduction of ten per cent in selling prices is made, revenue from sales is reduced from $6,000,000 to $5,400,000 at the budgeted volume. On the other hand, an increase of ten per cent in selling prices produces sales revenue of $6,600,000 at the same volume. On the chart, these changes in selling price alter the slope of the revenue line. In plotting, the three lines shown on the chart begin at the zero point as before. At the $6,000,000 volume the lines are drawn through points representing $6,600,000, $6,000,000 and $5,400,000 on the vertical scale. The effect which these price changes have upon the marginal income ratio, break-even volume, and profit before taxes is summarized below.

Selling prices	*Marginal income ratio*	*Break-even volume*	*Profit before taxes at budgeted volume*
Budgeted prices	35.0%	$4,200,000	$ 630,000
Ten per cent reduction	27.8	5,287,000	30,000
Ten per cent increase	41.0	3,585,000	1,230,000

Exhibit 5 has been drawn to illustrate the effect of a twenty per cent reduction in fixed costs. Since the amount of fixed cost drops to $1,176,000, the new fixed cost line is drawn at a height on the vertical scale representing the latter figure. This also reduces the height of the total cost line without changing its slope. As may be seen from the chart, the break-even point is lowered to $3,360,000 and the profit at any given volume above the break-even point is increased by the amount of the reduction in fixed costs ($294,000).

Exhibit 6 illustrates the changes in the chart which would result from a reduction of fifteen per cent in variable costs accompanied by a twenty per cent increase in fixed costs. In this chart, the increased amount of fixed cost raises the fixed cost line while the reduction in the ratio of variable costs to volume causes the total cost line to slope upward less steeply than before. As a result of these changes in cost structure, the break-even point is reduced from $4,200,000 to $3,946,000 and the marginal income ratio is increased from 35.0 per cent to 44.7 per cent.

Exhibit 7 has been prepared to illustrate the effects of a change in sales mix. Since only the over-all result of changes in sales mix can be shown in a break-even chart, the exhibit utilizes figures to present details for individual products.

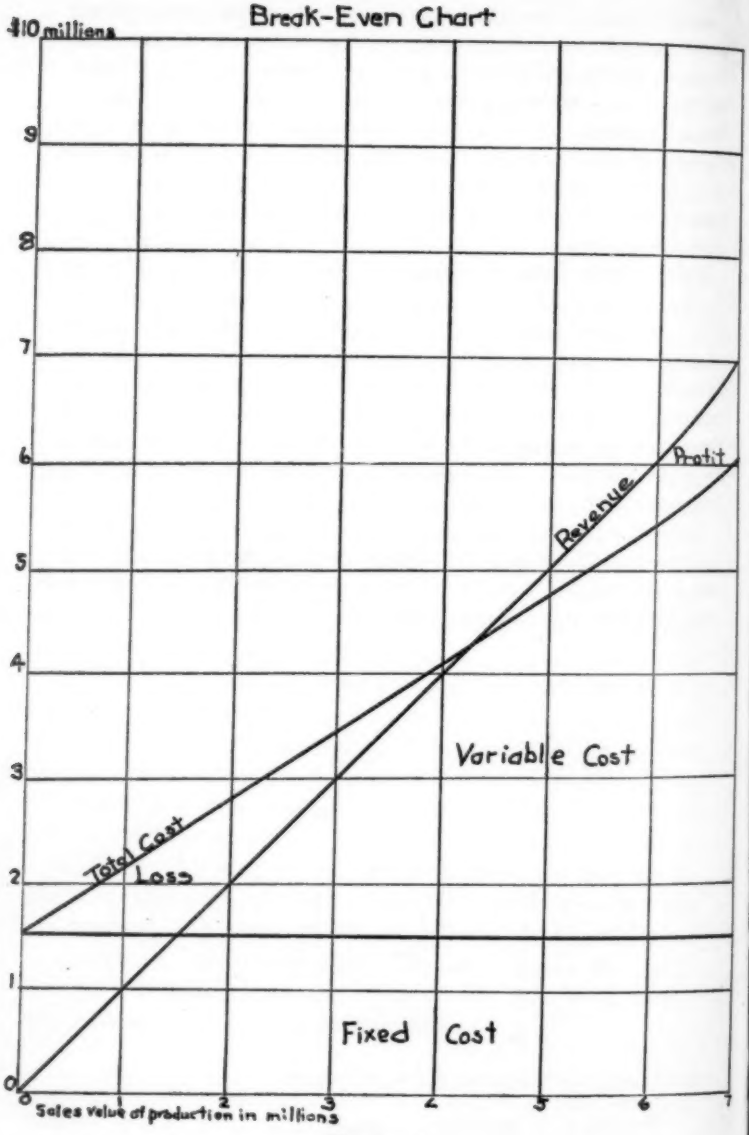
Break-Even Chart
10 millions
9
8
7
6
5
4
3
2
1
0
Profit
Revenue
Variable Cost
Total Cost
Loss
Fixed Cost
0
1
2
3
4
5
6
7
Sales value of production in millions

EXHIBIT 1

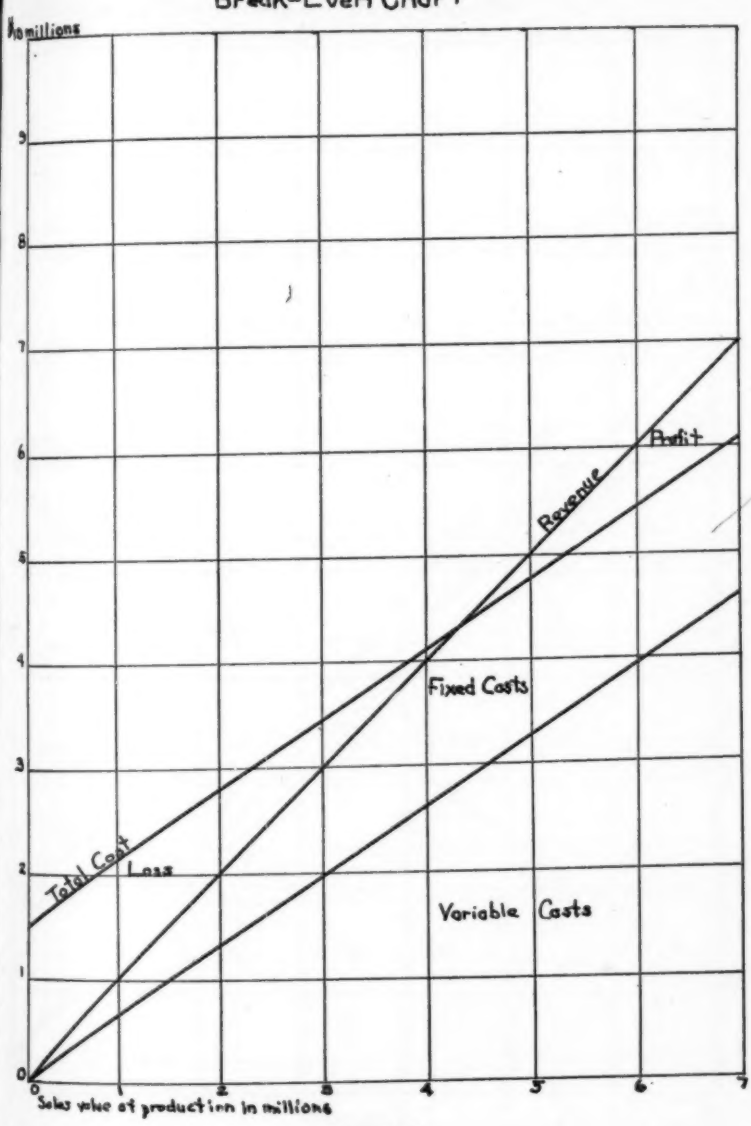
Break-Even Chart
In millions
9
8
7
6
5
4
3
2
1
0
Profit
Revenue
Fixed Costs
Total Cost
Loss
Variable Costs
0
1
2
3
4
5
6
7
Sales value of production in millions

EXHIBIT 2

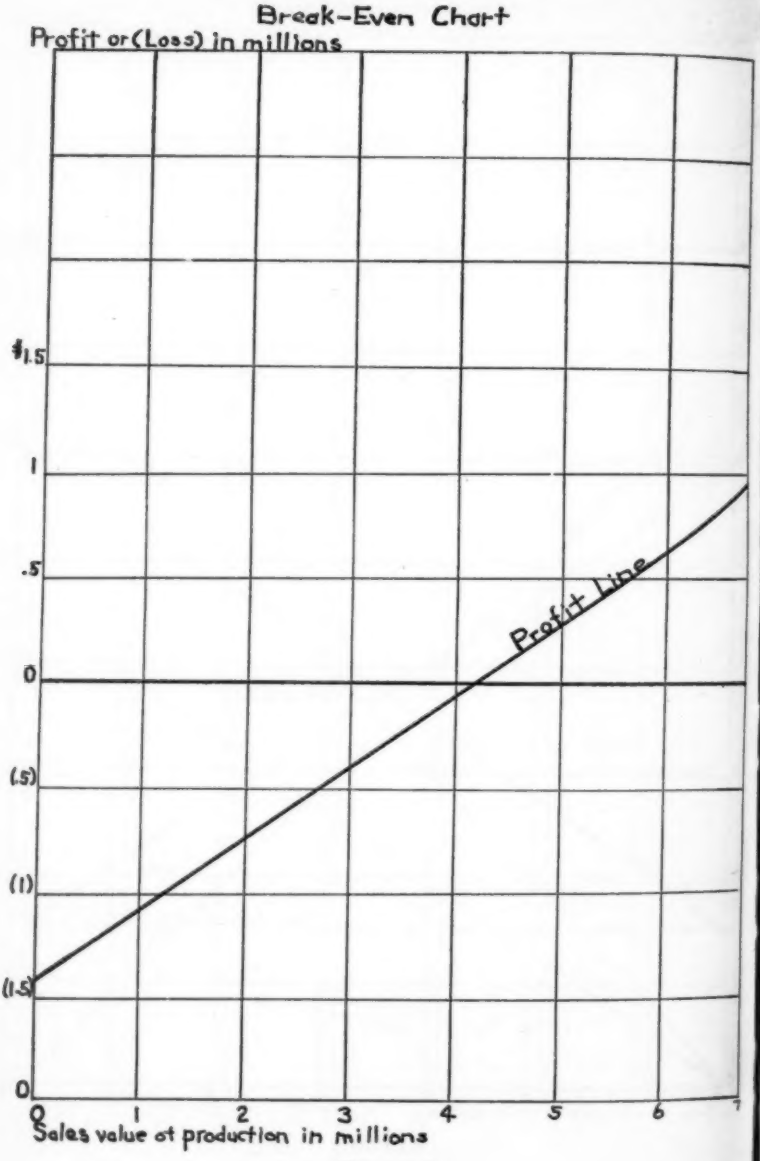
Break-Even Chart
Profit or (Loss) in millions
$1.5
1
.5
0
(.5)
(1)
(1.5)
0
0
1
2
3
4
5
6
7
Profit Line
Sales value of production in millions

EXHIBIT 3

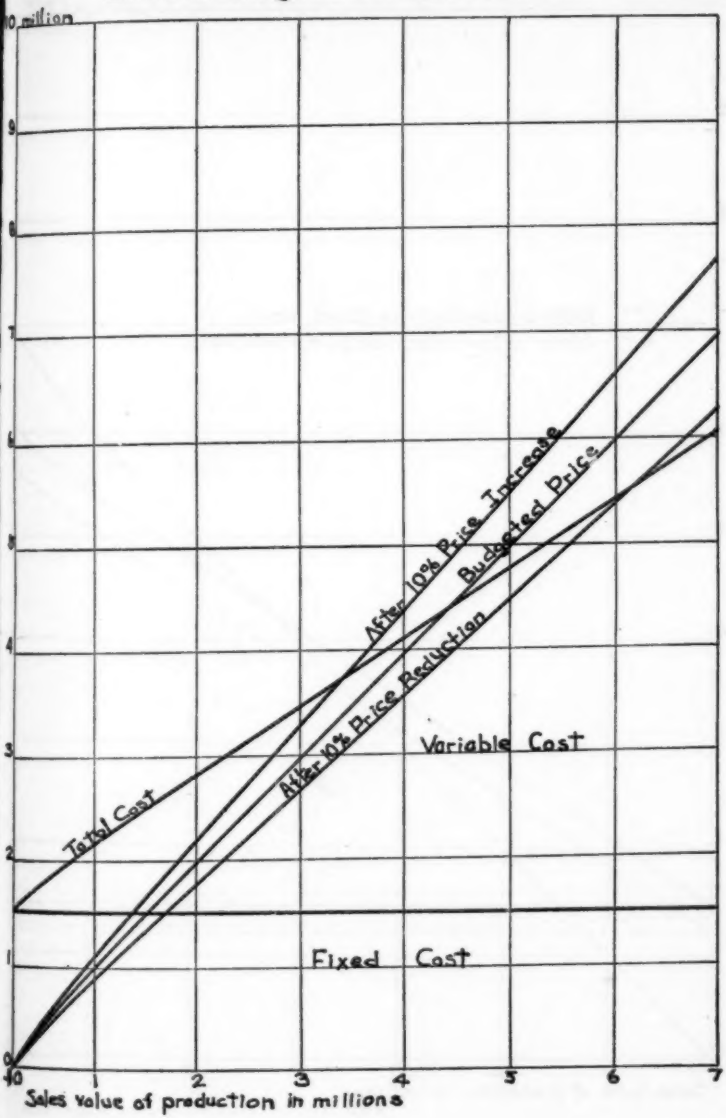
Effect of Change in Selling Price
10 million
9
8
7
6
4
3
2
1
0
10
1
2
3
4
5
6
7
Sales value of production in millions
After 10% Price Increase
Budgeted Price
After 10% Price Reduction
Variable Cost
Total Cost
Fixed Cost

EXHIBIT 4

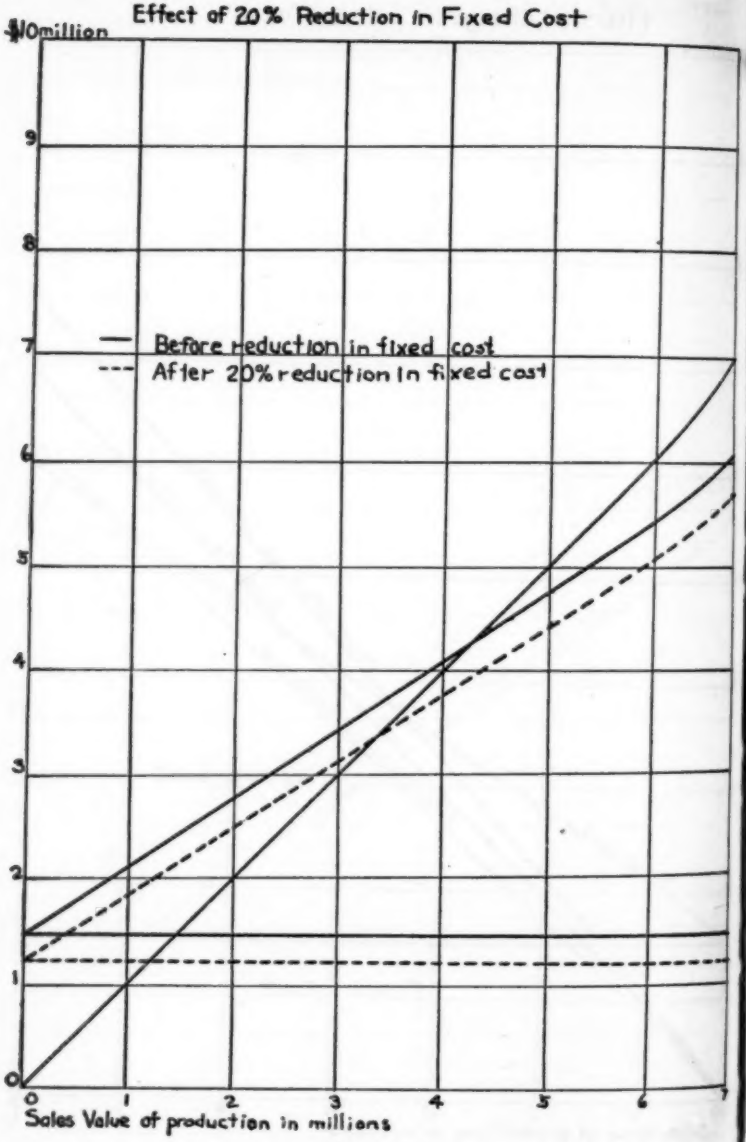
Effect of 20% Reduction in Fixed Cost
$10million
9
8
7
6
5
4
3
2
1
0
Before reduction in fixed cost
After 20% reduction in fixed cost
0
1
2
3
4
5
6
7
Sales Value of production in millions

EXHIBIT 5

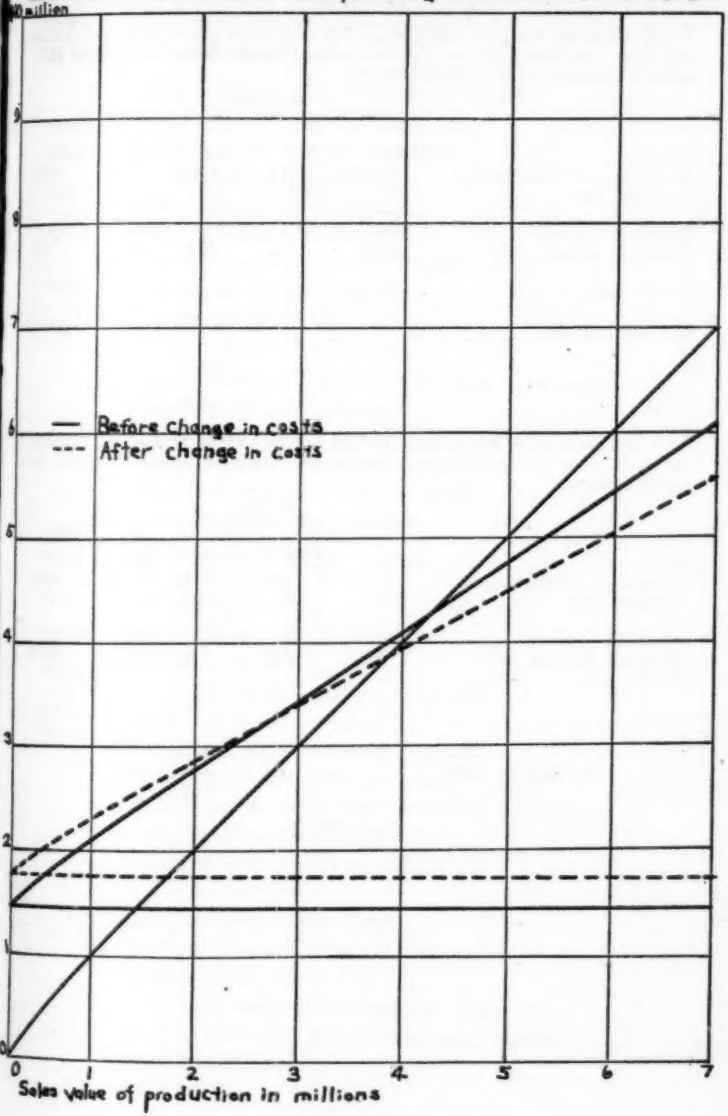
20% Increase in Fixed Cost Accompanied By 15% Reduction in Variable Cost
10 million
9
8
7
6
5
4
3
2
1
0
— Before change in costs
--- After change in costs
0
1
2
3
4
5
6
7
Sales value of production in millions

EXHIBIT 6

Effect of Shift in Sales Mix
(000 omitted)

Assuming the budgeted sales of $6,000 represents sales of four products which are expected to be sold in the mixture shown below, a profit of $630 and a break-even point of $4,200 results.

	Product				
	A	B	C	D	Totals
Sales	$2,000	$2,500	$1,000	$500	$6,000
Percentage of total sales	33⅓%	41⅔	16⅔	8⅓	100%
Variable cost	1,200	1,700	800	200	3,900
Marginal balance	$ 800	$ 800	$ 200	$300	$2,100
Marginal income ratio	40%	32%	20%	60%	35%
Fixed costs					$1,470
Operating profit					$ 630

Break-even point: $\frac{\$1470}{0.35} = \$4,200$

If, however, sales should shift toward a larger proportion of the products carrying lower marginal income ratios, the following figures illustrate the possible results:

	Product				
	A	B	C	D	Totals
Sales	$1,500	$2,200	$2,000	$300	$6,000
Percentage of total sales	25%	36⅔	33⅓	5%	100%
Variable cost	900	1,496	1,600	120	4,116
Marginal balance	$ 600	$ 704	$ 400	$180	$1,884
Marginal income ratio	40%	32%	20%	60%	.314%
Fixed costs					$1,470
Profit					$ 414

Break-even point: $\frac{\$1470}{0.314} = \$4,681$

Exhibit 7

The following companies were among those participating in this N. A. C. A. research study by contributing information regarding their use of cost-volume-profit analysis methods: The remaining companies preferred that their names not be listed.

Allis-Chalmers Manufacturing Company
American Machine & Metals, Inc.
American Viscose Corporation
A. O. Smith Corporation
Armstrong Cork Company
B. F. Goodrich Company
Bigelow-Sanford Carpet Company, Inc.
Bridgeport Brass Company
Celotex Corporation
Electric Auto-Lite Company
Farrell-Birmingham Company
Hamilton Watch Company
Hyatt Bearings Division, General Motors Corporation
International Resistance Company
John A. Roebling's Sons Company
Johns Manville Corporation
Johnson & Johnson
Linen Thread Company
Oliver Corporation
Owens-Illinois Glass Company
Philco Corporation
Philip Morris & Company, Ltd., Inc.
Reed Roller Bit Company
Red Jacket Manufacturing Company
Remington Arms Company, Inc.
R. Wallace & Sons Manufacturing Company
Sangamo Electric Company
Seymour Manufacturing Company
S K F Industries
Spartan Aircraft Company
Sylvania Electric Products, Inc.
Thompson Products, Inc.
Transcontinental & Western Air, Inc.
Wrought Washer Manufacturing Company
York Corporation

ANSWERS